

# **TECHNICAL REPORT**

## **WRIA 19 INSTREAM FLOW STUDIES**



**Prepared for**  
**Clallam County**  
**and**  
**WRIA 19 Watershed Planning Unit**

Prepared by

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May 2005

**EES** Consulting

## 1.0 INTRODUCTION

The Water Resources Inventory Area (WRIA) 19 Instream Flow study focuses on the habitat, hydrologic and instream flow needs of anadromous salmonids. Primary emphasis was given to the spawning life history stage of Chinook, coho and chum salmon and steelhead trout, as well as ancillary emphasis to the rearing life history stages of Chinook and coho salmon and steelhead trout.

The study area is further subdivided into the following rivers and streams (referred to as the “Big 9”) and the number of study sites on each:

- Hoko River (1 Study Site)
- Sekiu River (1 Study Site)
- Clallam River (2 Study Sites)
- Pysht River (2 Study Sites)
- Deep Creek (1 Study Site)
- West Twin River (1 Study Site)
- East Twin River (1 Study Site)
- Lyre River (1 Study Site)
- Salt Creek (1 Study Site)

## 2.0 METHODOLOGY

In consultation with the Washington Department of Wildlife (WDFW) and the Washington Department of Ecology (WDOE) and with concurrence with the WRIA 19 Planning Unit, EES Consulting devised a study plan that would focus on determining appropriate flows for the spawning life stage of anadromous salmonids. Spawning occurs in these systems at the time of year when water may potentially be available in excess of instream needs. Habitat units were selected on each river system with a riffle being the downstream portion of the unit; the other parts of the habitat unit consisted of a pool/pool tailout/glide or run complex.

### 2.1 Study Site Selection

Study sites were selected in consultation with Mr. Jeff Shellberg, Mr. Doug Morrill and Mr. Mike Haggerty.

### 2.2 Field Methodology

Full calibration measurements (water depth, velocity) were taken at three calibration flows on the riffles, as well as water surface elevations at the calibration flows and substrates and cover at each station on the transect. The bed profiles were surveyed using an auto level and stadia rod. Bed profiles, water surface elevations, and substrate and cover were recorded for each of the upstream transects (pool, pool tailout, glide or run) associated with the riffles. Photographs were taken at each transect and flow.

This method was employed as a means to model as many streams as possible, using the Instream Flow Incremental Methodology, making best use of the limited dollars available.

### **2.3 Modeling Methods**

The WRIA 19 Instream Flow Studies were conducted using the Physical Habitat Simulation (PHABSIM) modeling approach, which is commonly referred to as the US Fish and Wildlife Service Instream Flow Incremental Methodology (IFIM). Whenever feasible, the three-flow regression method was used to hydraulically model flows on the riffles; when necessary to extend the modeling range, the “one velocity-set” method was used to model either upward or downward.

For the other portions of the habitat units, EES Consulting collected hydraulic information as it related to flow (e.g., wetted width, wetted perimeter, wetted area, hydraulic radius, and mean depth). EES Consulting also examined the applicability of using depth calibrations on these parts of the habitat units that did not have depths and velocities collected during the calibration flow measurements. Depth calibrations assume that the deepest part of the channel (e.g., the thalweg) has the highest velocities. EES Consulting used data from habitat units on the Peshastin Creek and the Wenatchee River which had depth and velocity data collected and ran the habitat models with the depth and velocity data and without the depth and velocity data (e.g., the depth calibration). The outputs were consistent between the two methods; therefore, EES Consulting performed depth calibrations on the transects upstream of the riffles.

EES Consulting met with Mr. James Pacheco of WDOE and Ms. Terra Hegy of WDFW throughout this process regarding model calibration, use of HSI curves, means of interpreting results, and recommending flows. A calibration report for each of the streams modeled is available.

### **2.4 Habitat Suitability Indices**

EES Consulting used the Habitat Suitability Index (HSI) curves as provided by the Washington Department of Ecology (WDOE) and the Washington Department of Fish and Wildlife (WDFW) in their most recent instream flow guidelines (2004). Species and life stages used in the modeling effort were: Chinook salmon spawning and rearing; coho salmon spawning and rearing; chum salmon spawning; and steelhead trout spawning and rearing.

### **2.5 Hydrology**

Hydrology was developed by the U.S. Bureau of Reclamation for the “Big 9” rivers and streams. Data from the Hoko River were used to synthesize long-term hydrologic records for the other streams in WRIA 19. Currently, stream gages are being installed on other systems within WRIA 19 to verify the synthetic record.

## 2.6 Salmon and Steelhead Periodicity

Salmon and steelhead periodicity is provided; this chart was developed in consultation with the WRIA 19 Planning Unit. Lyre chum were noted to spawn later than chum in the other Big 9 rivers and streams.

## 2.7 Salmon and Steelhead Presence and Absence

Salmon and steelhead presence or absence in each stream is attached and was determined in consultation with the WRIA 19 Planning Unit. Although Chinook salmon are not currently present in all of the systems modeled, the Planning Unit wished to have the habitat assessed for Chinook salmon spawning and rearing; accordingly, Chinook salmon spawning and rearing curves were run for each stream.

# 3.0 RESULTS

A principal product of PHABSIM is the Weighted Usable Area (WUA) chart, which is a quantifiable index of habitat value, relative to flow. Typically, flows ranging from 0.4 of the low calibration flow to 2.5 times the high calibration flow can be modeled, depending upon model performance. This document reports WUA results for rearing salmonids including Chinook and coho salmon and steelhead trout. WUA results for spawning salmonids are reported for Chinook, coho and chum salmon, and steelhead trout.

# 4.0 DISCUSSION

## 4.1 Interpretation of Results

### 4.1.1 Methods for Examining WUA

In some cases, there may be only one species and life history stage present during a particular time period. For example, during the month of November on the Lyre River, spawning coho salmon are the only species examined. However, during other time periods (i.e., December) there are several species that are spawning (coho and chum salmon and steelhead trout) while in the spring months (e.g., May), there may be a combination of spawning and rearing by several species. The question exists on how to address flows when there is more than one species or life history stage present.

There are several valid means to address instream flow requirements when there are multiple species and life history stages present. They all have trade-offs and pros and cons. The two that EES Consulting examined were:

1. Use of a Priority Species. Under this method, a priority species is identified for a

particular time period and the flows which maximize the habitat for this species are used. The advantage of this method is that it provides maximum protection for the priority species. The disadvantage is that it does not necessarily provide as much protection for ancillary species. For example, if a priority species has the greatest amount of WUA at a flow of 100 cfs for a given system, and other species have the highest amount of habitat at lower flows, then habitat could be lost for these species at the higher flows required for the priority species.

2. Balanced Approach. Under this method, all species and life history stages for the given time period are considered in the determination of the optimum habitat for that given time period. In some instances, spawning is weighted more heavily than rearing, or certain species are weighted more heavily than others. EES Consulting weighted all species and life history stages equally for months with more than one species and/or life history stage. The advantage of the balanced approach is that it considers the needs of all species and life history stages when determining instream flow needs. The disadvantage of this method is that in balancing requirements of all species, it might not necessarily reflect the optimum habitat for any of species or life history stages.

This report presents the results of both approaches for the WRIA 19 Initiating Governments and the Planning Unit to discuss for each of the Big 9 rivers and streams. For the most part, the two methods track fairly well, with some differences in the winter spawning months.

#### **4.2 Incorporation of Hydrology**

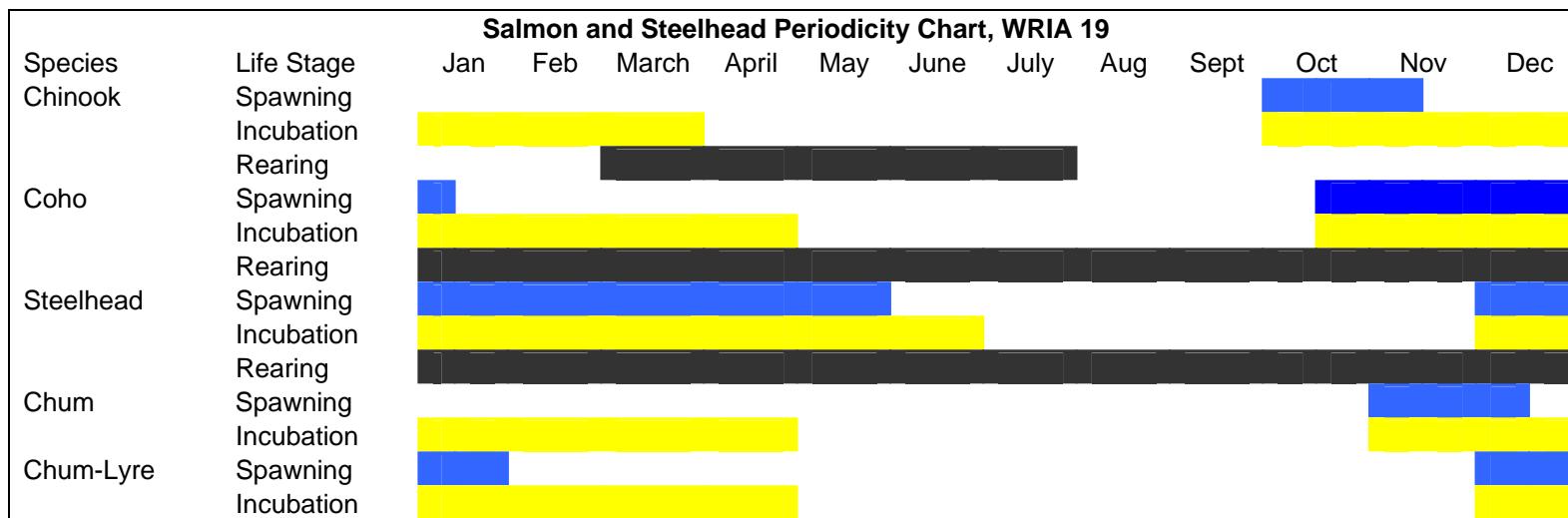
As can be observed in the generation of WUA for the Big 9 rivers streams, the models indicate in all instances that flow requirements to optimize habitat for rearing salmonids during the summer months exceed the flows available in those rivers and streams. In consultation with WDFW and WDOE, the 10% exceedance flow for that time period was used as the instream flow requirement when this situation occurred. [Note: the BOR synthesized hydrology gave 9% and 11% exceedance values; these two values were averaged to determine the 10% exceedance values].

#### **4.3 Flow Allocations**

Streams where fish habitat requirements met or exceeded the existing flow year-round were: Salt Creek; Deep Creek; East Twin River, and West Twin River. Those rivers with water available for out-of-stream uses were: Hoko, Sekiu, Clallam, Pysht, and Lyre Rivers. Water is available during the winter months on these streams. On all rivers, existing summer flows were required for fish habitat needs.

When water was available, and consistent with WDOE and WDFW policy, 10% of the median flow for those months was calculated and would be available for out of stream uses. This use is conditioned on water withdrawals not decreasing flows to a level below the instream flows set for that time period.





# **SEKIU RIVER INSTREAM FLOW RECOMMENDATIONS**

Prepared for:

**WRIA 19 Planning Unit**

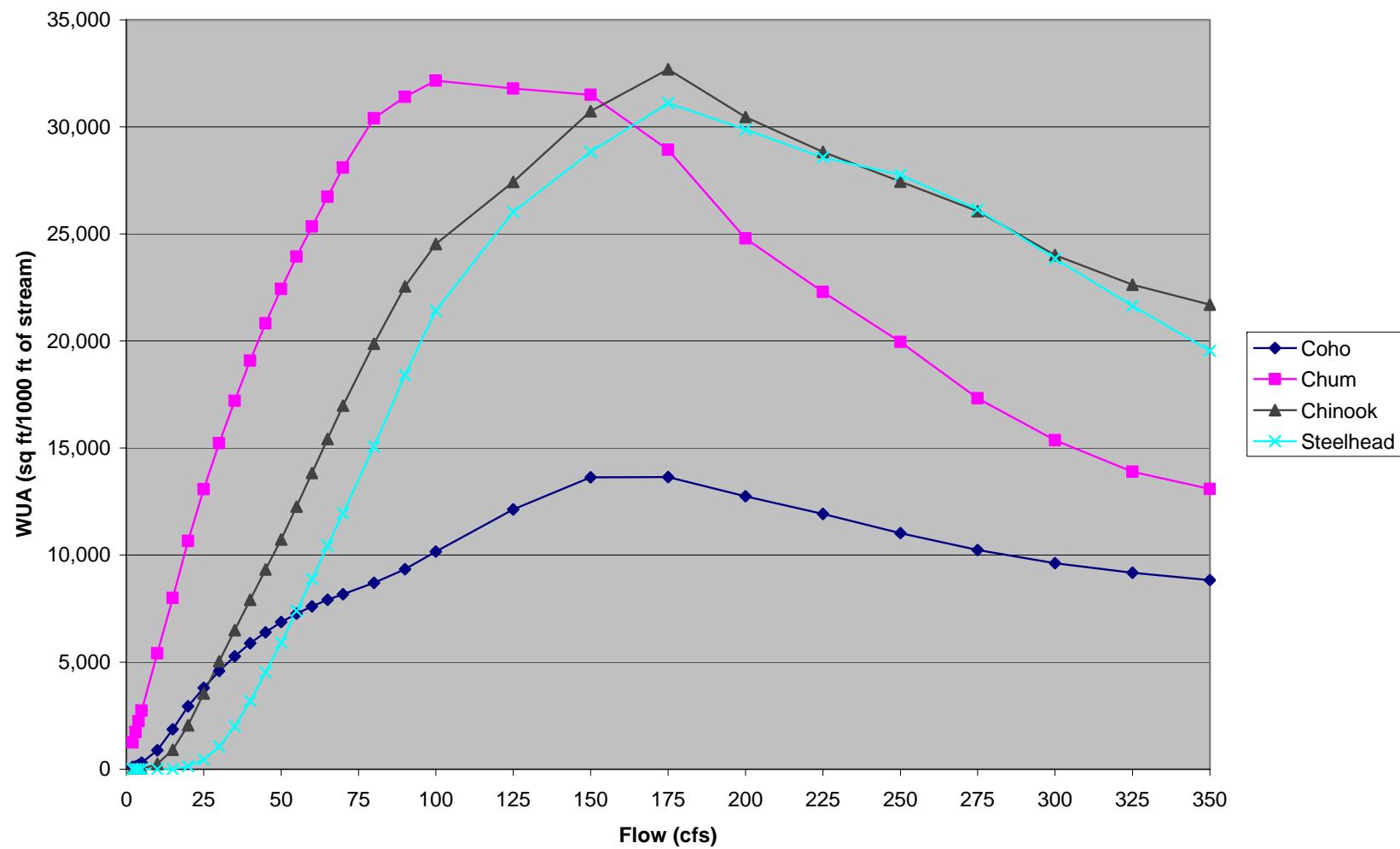
Prepared by:

**EES Consulting**

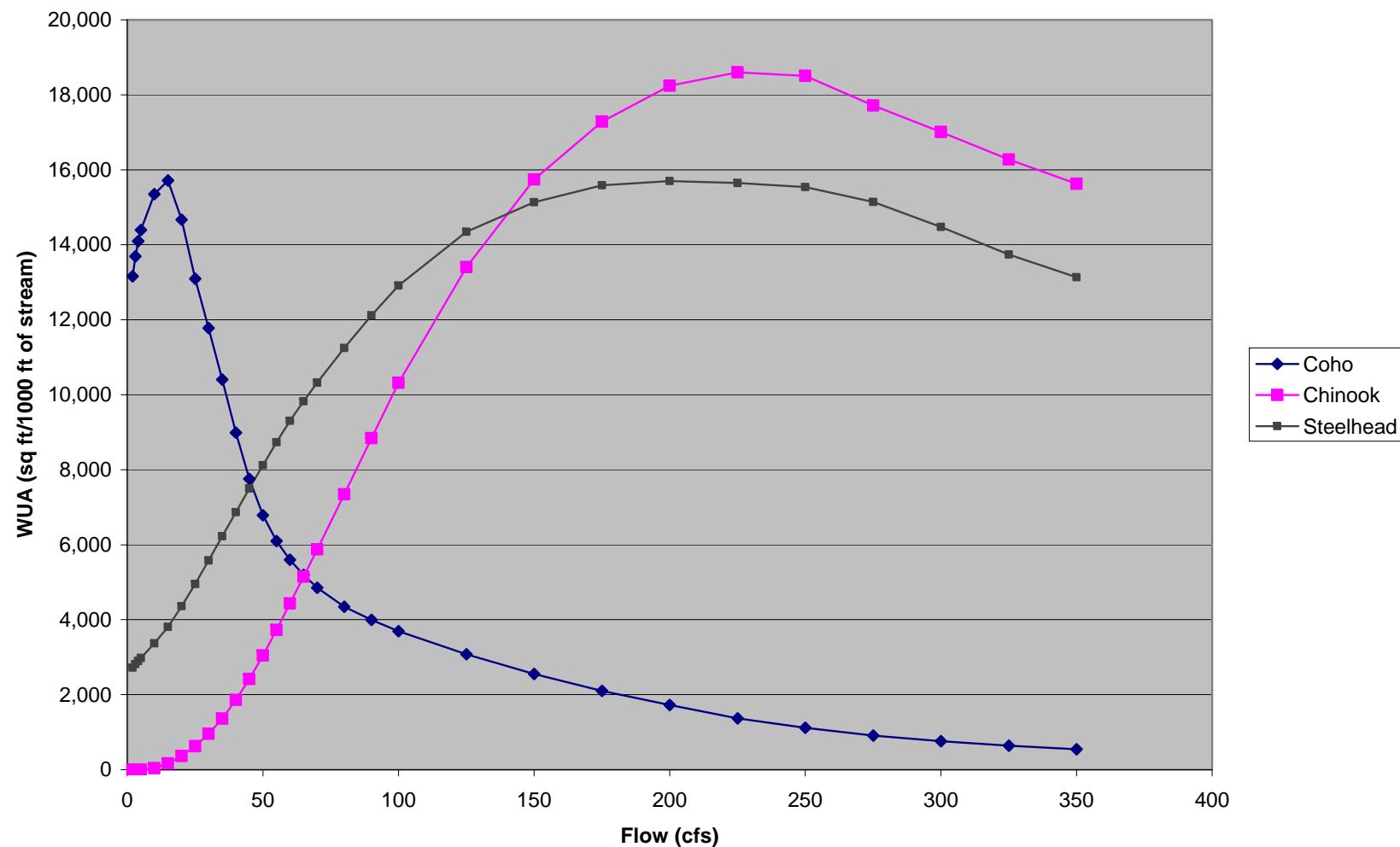
May 2005

Sekiu River Weighted Usable Area								
Flow	Transect 1 (Riffle) Spawning WUA				Flow	Sekiu River Transects 2 - 4 Rearing WUA		
	Coho	Chum	Chinook	Steelhead		Coho	Chinook	Steelhead
2	105	1,255	0	0	2	13,161	0	2,726
3	134	1,737	0	0	3	13,696	0	2,814
4	195	2,238	0	0	4	14,098	0	2,898
5	309	2,730	0	0	5	14,393	0	2,978
10	885	5,414	244	0	10	15,349	42	3,367
15	1,861	7,996	908	0	15	<b>15,713</b>	168	3,808
20	2,931	10,655	2,049	147	20	14,671	361	4,362
25	3,798	13,082	3,533	448	25	13,095	629	4,956
30	4,583	15,221	5,038	1,061	30	11,777	955	5,583
35	5,275	17,206	6,500	1,991	35	10,405	1,364	6,226
40	5,880	19,075	7,907	3,184	40	8,987	1,862	6,869
45	6,388	20,831	9,322	4,532	45	7,753	2,422	7,501
50	6,871	22,430	10,736	5,907	50	6,787	3,046	8,122
55	7,270	23,942	12,260	7,399	55	6,096	3,724	8,732
60	7,605	25,338	13,832	8,884	60	5,602	4,437	9,305
65	7,909	26,735	15,427	10,431	65	5,193	5,152	9,827
70	8,170	28,103	16,980	11,940	70	4,849	5,879	10,322
80	8,706	30,404	19,871	15,072	80	4,348	7,348	11,246
90	9,342	31,398	22,543	18,407	90	3,995	8,842	12,117
100	10,161	<b>32,163</b>	24,529	21,409	100	3,690	10,314	12,914
125	12,132	31,795	27,428	26,025	125	3,076	13,404	14,347
150	13,635	31,500	30,728	28,831	150	2,557	15,738	15,135
175	<b>13,649</b>	28,931	<b>32,689</b>	<b>31,105</b>	175	2,100	17,282	15,584
200	12,752	24,790	30,456	29,872	200	1,723	18,243	<b>15,697</b>
225	11,923	22,293	28,829	28,570	225	1,370	<b>18,600</b>	15,648
250	11,021	19,954	27,447	27,762	250	1,119	18,505	15,536
275	10,230	17,327	26,056	26,145	275	911	17,713	15,143
300	9,618	15,363	24,008	23,845	300	762	17,007	14,476
325	9,176	13,897	22,633	21,635	325	640	16,274	13,740
350	8,830	13,085	21,700	19,537	350	546	15,630	13,134
	13,649	32,163	32,689	31,105		15,713	18,600	15,697
	175	100	175	175		15	225	200

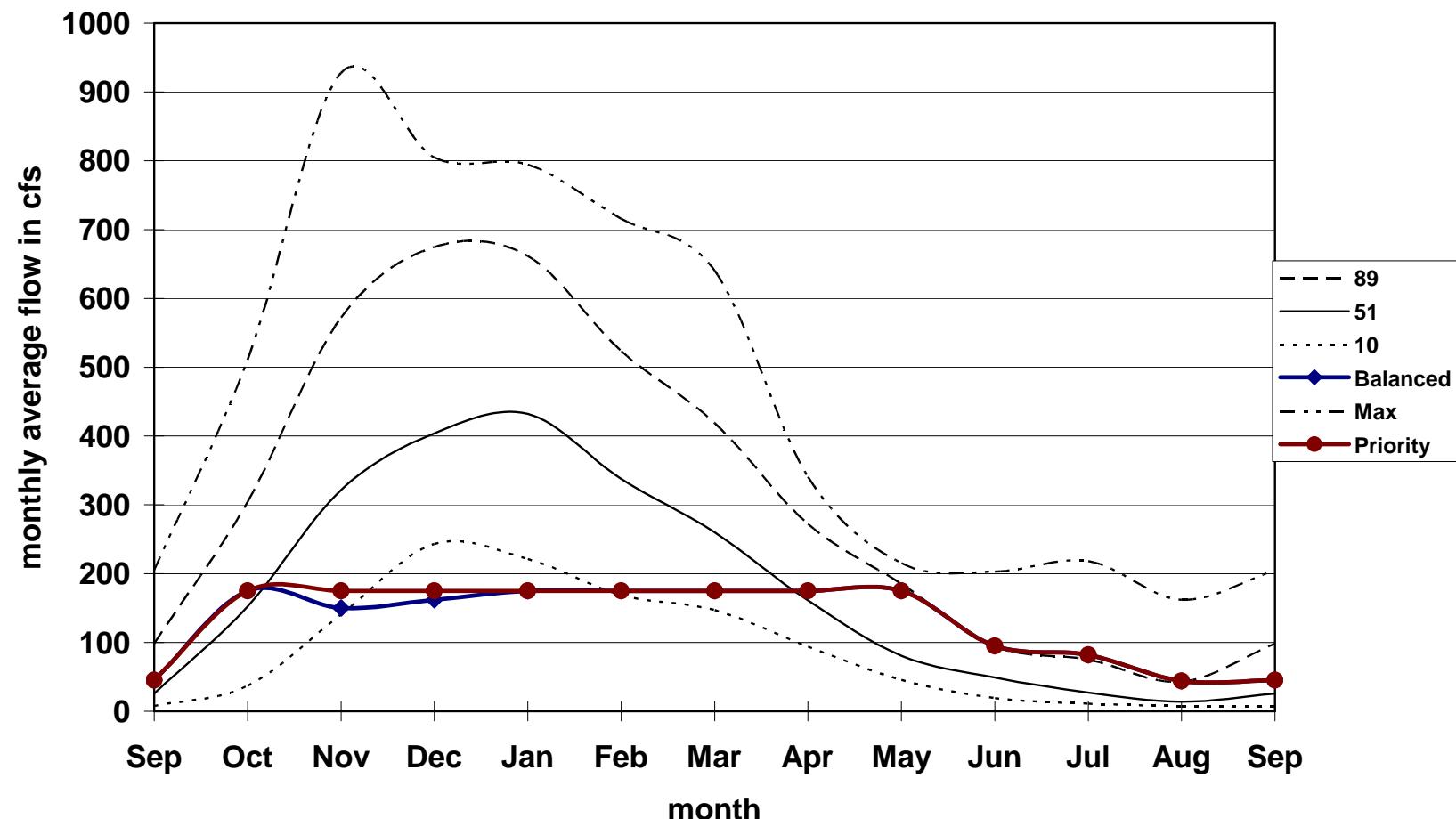
### Sekiu River Spawning WUA - Transect 1 (Riffle)



### Sekiu River Rearing WUA - Transects 2 - 4



**Sekiu River at Outlet 1962 - 99**  
**% time flow less than or equal to**



Summary of Suggested Flows, Sekiu River								
	ChS	CoS	CmS	ShS	CoR	ChR	ShR	
Max WUA	175	175	100	175	15	225	200	
Month/Days	Species and Life Stage			Suggested Flows		Hydrology		
	Priority	Balanced	Mean	10% Ex	Comments			
Oct 1-15	ShR	CoR	<b>ChS</b>	175	175	170	319	Max Bal WUA
Oct 15-31	<b>ChS</b>	<b>CoS</b>		175	175	170	319	Max Bal WUA
Nov 1-15	<b>ChS</b>	<b>CoS</b>	CmS	175	150	377	632	Max Bal WUA
Nov 16-30	<b>CoS</b>	CmS		175	150	377	632	Max Bal WUA
Dec 1-15	<b>CoS</b>	CmS	<b>ShS</b>	175	150	432	691	Max Bal WUA
Dec 16-31	<b>CoS</b>	<b>ShS</b>		175	175	432	691	Max Bal WUA
Jan 1-15	<b>CoS</b>	<b>ShS</b>		175	175	434	666	Max Bal WUA
Jan 16-31	<b>ShS</b>			175	175	434	666	Max WUA
Feb	<b>ShS</b>			175	175	347	531	Max WUA
March	<b>ShS</b>	ShR	CoR	ChR	175	175	426	Max Bal WUA
April	<b>ShS</b>	ShR	CoR	ChR	175	175	274	Max Bal WUA
May	<b>ShS</b>	ShR	CoR	ChR	ShE	175	100	Max Bal WUA Max Bal WUA =
June		ShR	CoR	<b>ChR</b>	ShE	95	55	95 200 Max Bal WUA =
July		ShR	CoR	<b>ChR</b>		82	39	82 200
Aug		<b>ShR</b>	CoR			44	23	44
Sept		<b>ShR</b>	CoR			45	45	45
<i>Flow Allocation: 10% Median Flow, Nov - March = 35.0 cfs</i>								
CoR	Coho Rearing		ShR	Steelhead Rearing				
CoS	Coho Spawning		ShS	Steelhead Spawning				
ChR	Chinook Rearing		ShE	Steelhead Emergence				
ChS	Chinook Spawning		<b><i>Bold = Priority Species</i></b>					
CmS	Chum Spawning							

**Sekiu River Combined Study Sites WUA, using the balanced approach of averaging WUA for species and life stages.**

Flow	ShR/CoR		ChS/CoS/		CoS/CmS/		ShS/ShR/		ShR/CoR/	
	/ChS	ChS/CoS	CmS	CoS/CmS	ShS	CoS/ShS	CoR/ChR	ChR	ShR/CoR	
2	5,295	53	453	680	453	53	3,972	5,295	7,943	
3	5,503	67	624	935	624	67	4,127	5,503	8,255	
4	5,665	97	811	1,216	811	97	4,249	5,665	8,498	
5	5,790	155	1,013	1,520	1,013	155	4,343	5,790	8,686	
10	6,320	565	2,181	3,150	2,100	443	4,689	6,252	9,358	
15	6,810	1,384	3,588	4,929	3,286	930	4,922	6,563	9,761	
20	7,027	2,490	5,212	6,793	4,577	1,539	4,885	6,465	9,516	
25	7,195	3,666	6,805	8,440	5,776	2,123	4,782	6,227	9,026	
30	7,466	4,810	8,281	9,902	6,955	2,822	4,844	6,105	8,680	
35	7,710	5,887	9,660	11,240	8,157	3,633	4,997	5,998	8,316	
40	7,921	6,893	10,954	12,478	9,380	4,532	5,225	5,906	7,928	
45	8,192	7,855	12,180	13,609	10,584	5,460	5,552	5,892	7,627	
50	8,549	8,804	13,346	14,651	11,736	6,389	5,966	5,985	7,455	
55	9,029	9,765	14,491	15,606	12,870	7,335	6,488	6,184	7,414	
60	9,580	10,719	15,592	16,471	13,942	8,244	7,057	6,448	7,453	
65	10,149	11,668	16,691	17,322	15,025	9,170	7,651	6,724	7,510	
70	10,717	12,575	17,751	18,137	16,071	10,055	8,247	7,017	7,585	
80	11,822	14,289	19,660	19,555	18,061	11,889	9,503	7,647	7,797	
90	12,885	15,943	21,094	20,370	19,716	13,875	10,840	8,318	8,056	
100	13,711	17,345	22,284	21,162	21,245	15,785	12,082	8,973	8,302	
125	14,951	19,780	23,785	21,963	23,317	19,079	14,213	10,276	8,712	
150	16,140	22,181	<b>25,288</b>	22,568	<b>24,655</b>	21,233	15,565	11,143	8,846	
175	<b>16,791</b>	<b>23,169</b>	25,090	21,290	24,562	22,377	<b>16,518</b>	11,655	8,842	
200	15,959	21,604	22,666	18,771	22,471	21,312	16,384	11,888	8,710	
225	15,283	20,376	21,015	17,108	20,929	20,247	16,047	11,873	8,509	
250	14,701	19,234	19,474	15,487	19,579	19,391	15,730	11,720	8,327	
275	14,037	18,143	17,871	13,779	17,901	18,188	14,978	11,256	8,027	
300	13,082	16,813	16,330	12,491	16,276	16,732	14,022	10,748	7,619	
325	12,338	15,905	15,235	11,537	14,903	15,406	13,072	10,218	7,190	
350	11,793	15,265	14,538	10,958	13,817	14,183	12,212	9,770	6,840	
Max WUA Flow	16,791	23,169	25,288	22,568	<b>24,655</b>	22,377	<b>16,518</b>	11,888	9,761	
	175	175	150	150	150	175	175	200	15	

# **HOKO RIVER**

## **INSTREAM FLOW RECOMMENDATIONS**

Prepared for:

**WRIA 19 Planning Unit**

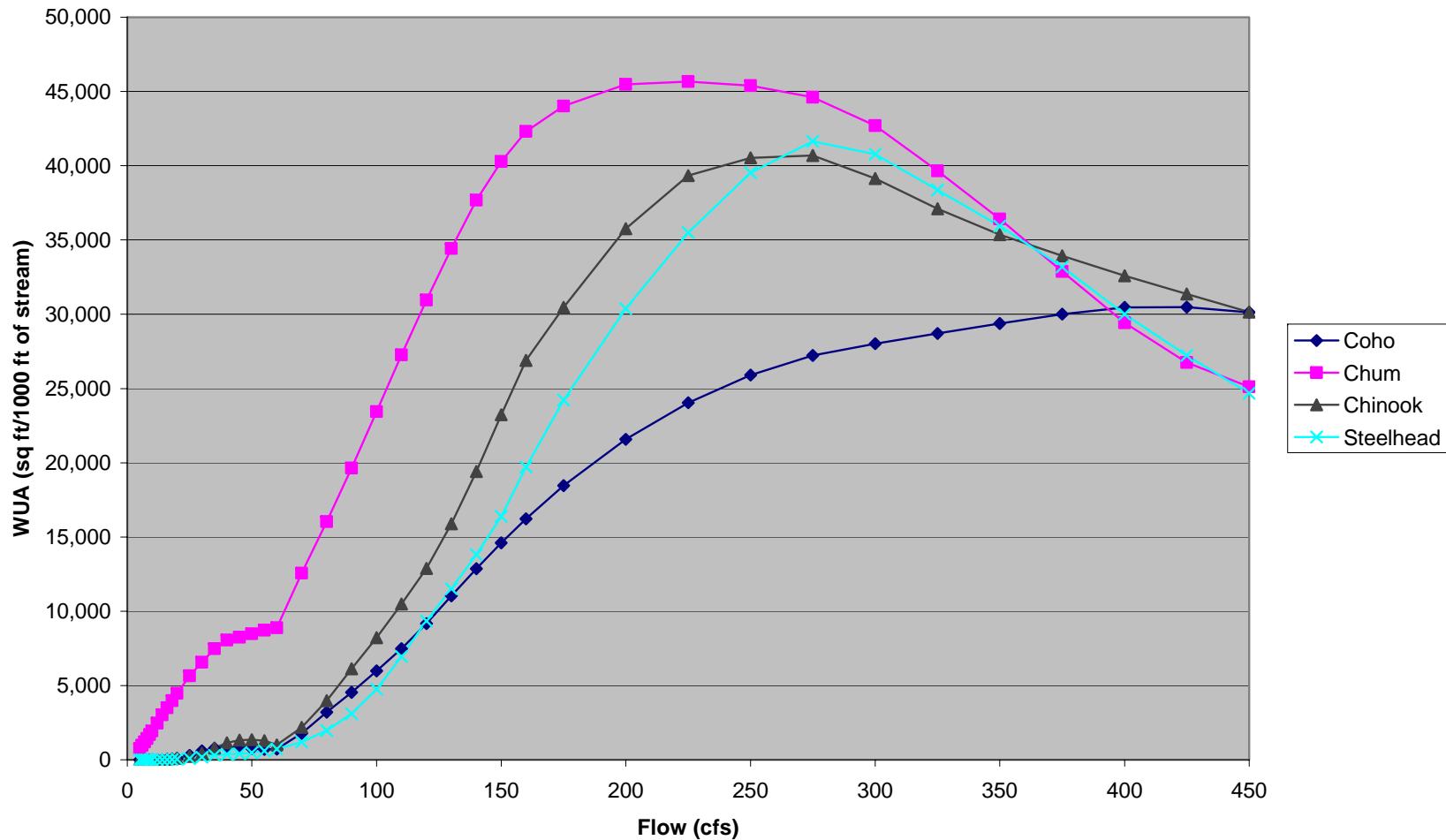
Prepared by:

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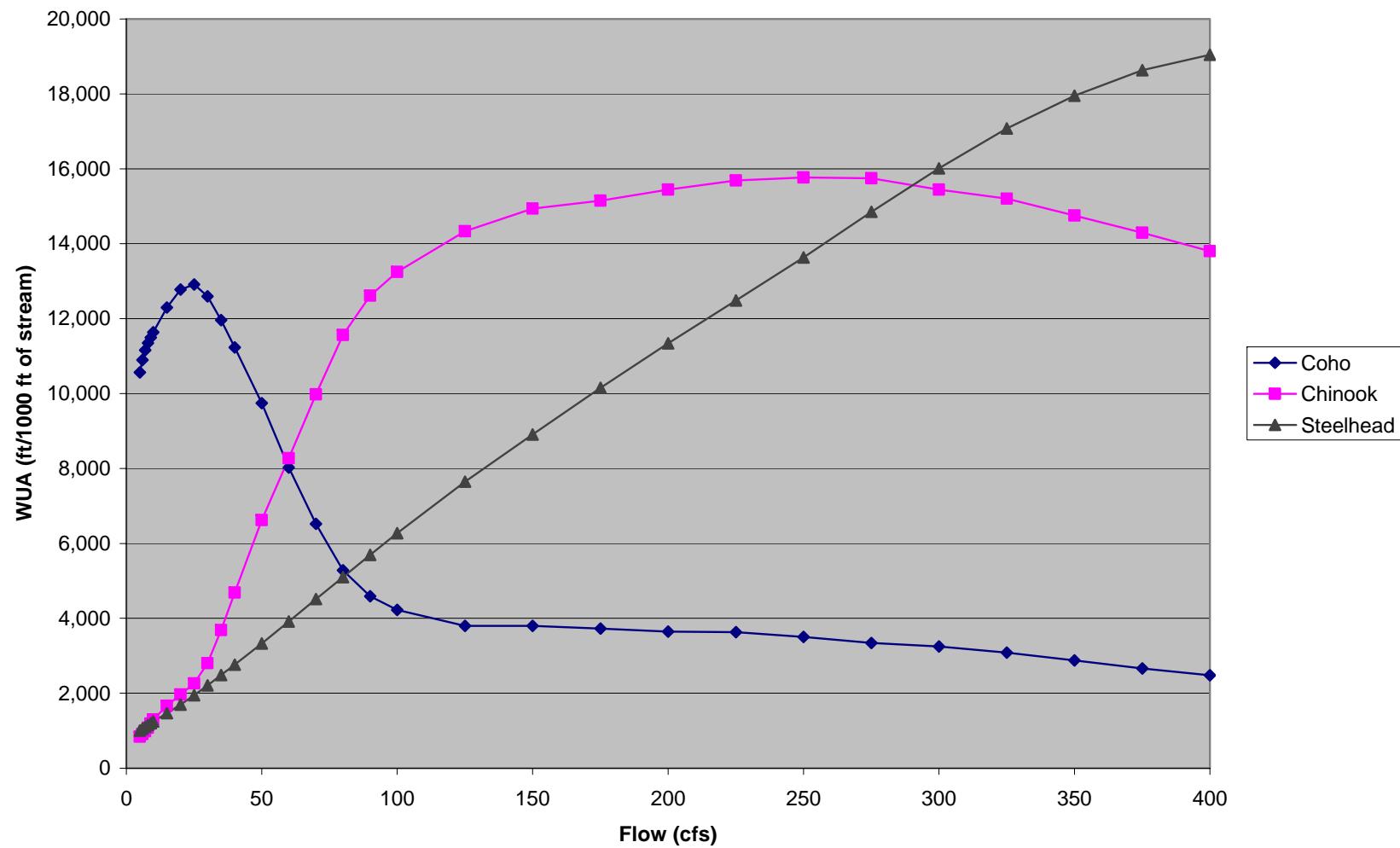
May 2005

Hoko River, Transect 1, Spawning WUA					Hoko River, Rearing WUA, Transects 2 - 4			
Flow	Coho	Chum	Chinook	Steelhead	Flow	Coho	Chinook	Steelhead
5	0	739	0	0	5	10,566	839	1,002
6	0	970	0	0	6	10,895	909	1,054
7	0	1,201	0	0	7	11,156	982	1,104
8	0	1,434	0	0	8	11,346	1,076	1,153
9	0	1,687	0	0	9	11,496	1,191	1,201
10	0	1,942	0	0	10	11,638	1,298	1,247
12	0	2,465	0	0	12	11,921	1,462	1,338
14	0	3,021	0	0	14	12,178	1,597	1,426
16	15	3,501	29	6	16	12,403	1,726	1,512
18	55	3,979	62	17	18	12,598	1,850	1,601
20	88	4,475	99	34	20	12,775	1,969	1,695
25	302	5,656	228	94	25	12,912	2,264	1,945
30	603	6,562	442	182	30	12,595	2,803	2,210
35	774	7,488	795	295	35	11,963	3,688	2,486
40	842	8,066	1,147	368	40	11,234	4,687	2,761
45	829	8,259	1,324	408	45	10,442	5,668	3,045
50	758	8,475	1,361	480	50	9,743	6,623	3,331
55	711	8,723	1,286	606	55	8,900	7,507	3,621
60	727	8,894	1,002	716	60	8,025	8,274	3,913
70	1,775	12,564	2,190	1,195	70	6,520	9,977	4,513
80	3,194	16,040	3,970	1,968	80	5,281	11,564	5,104
90	4,547	19,647	6,117	3,096	90	4,586	12,612	5,696
100	5,981	23,434	8,222	4,754	100	4,228	13,247	6,272
110	7,480	27,257	10,492	6,951	110	3,995	13,772	6,835
120	9,176	30,960	12,889	9,347	120	3,843	14,161	7,384
130	11,027	34,428	15,899	11,505	130	3,793	14,493	7,905
140	12,868	37,675	19,418	13,810	140	3,791	14,772	8,407
150	14,613	40,277	23,235	16,390	150	3,798	14,937	8,909
160	16,223	42,301	26,887	19,712	160	3,785	15,031	9,413
175	18,470	44,018	30,463	24,213	175	3,725	15,150	10,152
200	21,577	45,470	35,757	30,382	200	3,642	15,443	11,340
225	24,036	45,670	39,338	35,502	225	3,632	15,690	12,484
250	25,914	45,384	40,539	39,536	250	3,505	15,766	13,633
275	27,229	44,620	40,682	41,634	275	3,345	15,748	14,854
300	28,021	42,702	39,142	40,776	300	3,247	15,447	16,012
325	28,699	39,650	37,098	38,367	325	3,087	15,203	17,078
350	29,381	36,418	35,358	35,941	350	2,878	14,751	17,952
375	30,013	32,869	33,934	33,195	375	2,659	14,293	18,635
400	30,461	29,424	32,599	30,014	400	2,479	13,803	19,046
425	30,482	26,750	31,355	27,235	425	2,330	13,291	19,202
450	30,139	25,108	30,146	24,675	450	2,137	12,829	19,064
Max WUA Flow	30,482	45,670	40,682	41,634	12,912	15,766	19,046	
	425	225	275	275	25	250	400	

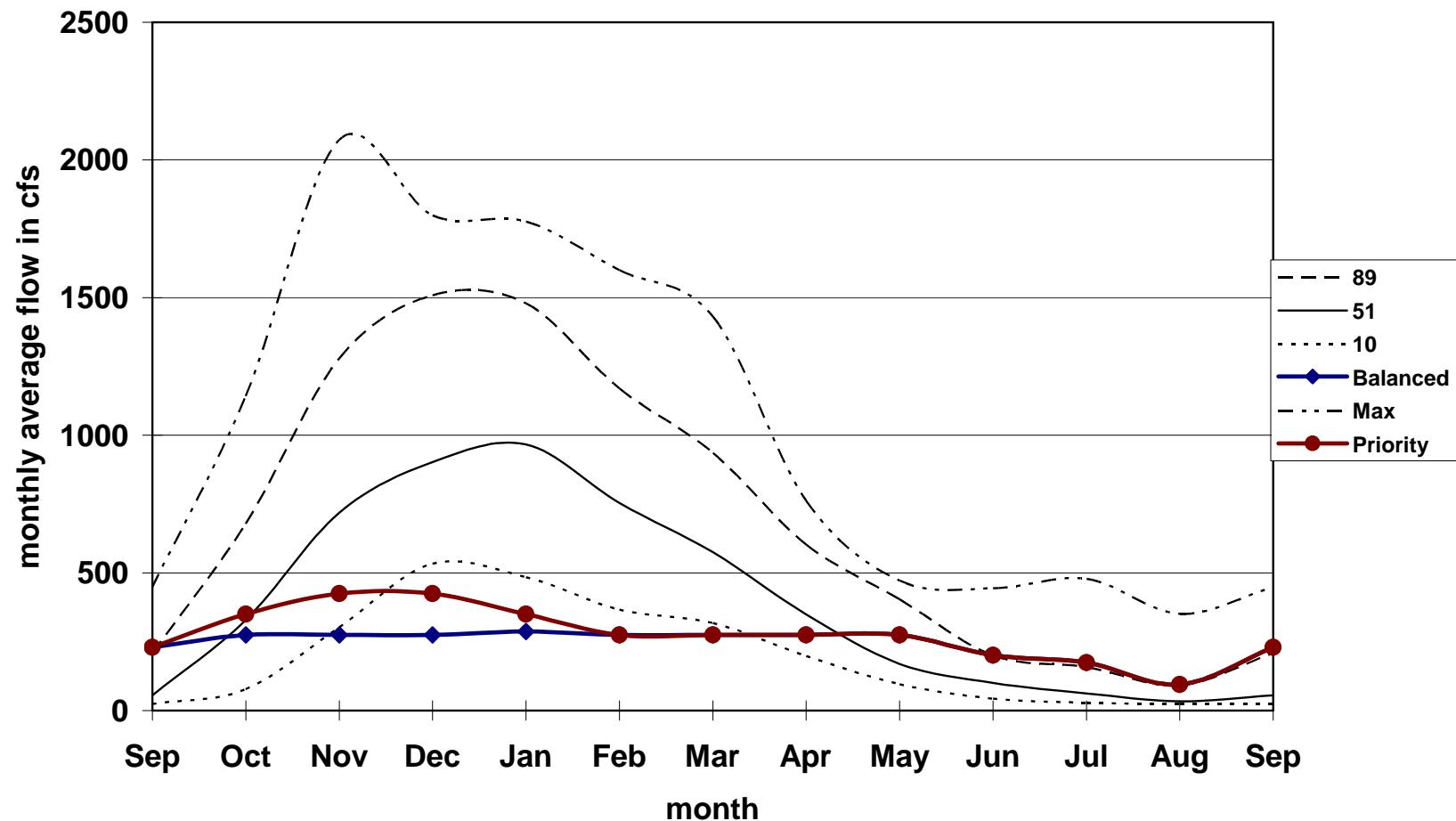
### Hoko River Spawning WUA Transect 1 - Riffle



### Hoko River Rearing WUA Transects 2 - 4



**Hoko River at Outlet 1962 - 99**  
**% time flow less than or equal to**



**Summary of Suggested Flow Recommendations, Hoko River**

Month/Days	Species and Life Stage	Suggested Flows			Hydrology (cfs)		Comments
		Priority	Balanced	Mean	10% Ex		
Oct 1-15	ShR	CoR	<b>ChS</b>	275	275	373	712 Max Bal = 275
Oct 15-31	ChS	<b>CoS</b>		425	275	373	712 Max Bal = 275
Nov 1-15	ChS	<b>CoS</b>	CmS	425	275	840	1,412 Max Bal = 275
Nov 16-30	<b>CoS</b>	CmS		425	275	840	1,412 Max Bal = 275
Dec 1-15	<b>CoS</b>	CmS	ShS	425	275	963	1,545 Max Bal = 275
Dec 16-31	<b>CoS</b>	ShS		425	275	963	1,545 Max Bal = 275
Jan 1-15	<b>CoS</b>	ShS		425	300	968	1,489 Max Bal = 300
Jan 16-31	<b>ShS</b>			275	275	968	1,489
Feb	<b>ShS</b>			275	275	773	1,188
March	<b>ShS</b>	<b>ShR</b>	CoR	275	275	618	952 Max Bal = 275
April	<b>ShS</b>	<b>ShR</b>	CoR	275	275	392	607 Max Bal = 275
May	<b>ShS</b>	<b>ShR</b>	CoR	275	275	212	408 Max Bal = 275
June		<b>ShR</b>	CoR	ChR	ShE	201	201 Max Bal = 350
July		<b>ShR</b>	CoR	ChR	ShE	174	87 174 Max Bal = 350
Aug		<b>ShR</b>	CoR			95	53 95 Max Bal = 425
Sept		<b>ShR</b>	CoR			230	230 Max Bal = 425
<i>Flow Allocation: 10% of Median Flow Nov - March = 78.1 cfs</i>							
CoR	Coho Rearing	ShR		Steelhead Rearing			
CoS	Coho Spawning	ShS		Steelhead Spawning			
ChR	Chinook Rearing	ShE		Steelhead Emergence			
ChS	Chinook Spawning						
CmS	Chum Spawning			<b><i>Bold = Priority Species</i></b>			



# **CLALLAM RIVER**

## **INSTREAM FLOW RECOMMENDATIONS**

Prepared for:

**WRIA 19 Planning Unit**

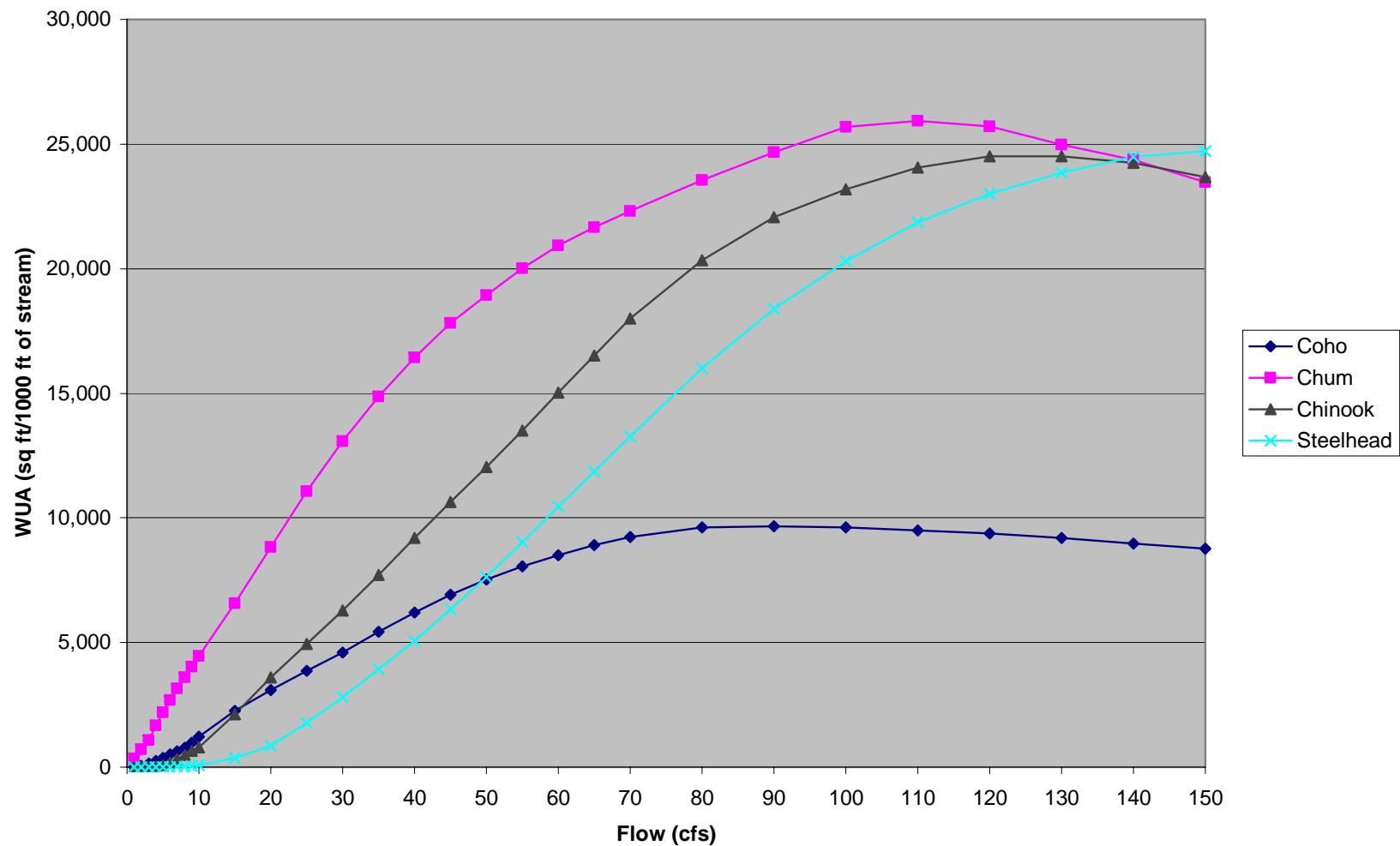
Prepared by:

**EES Consulting**

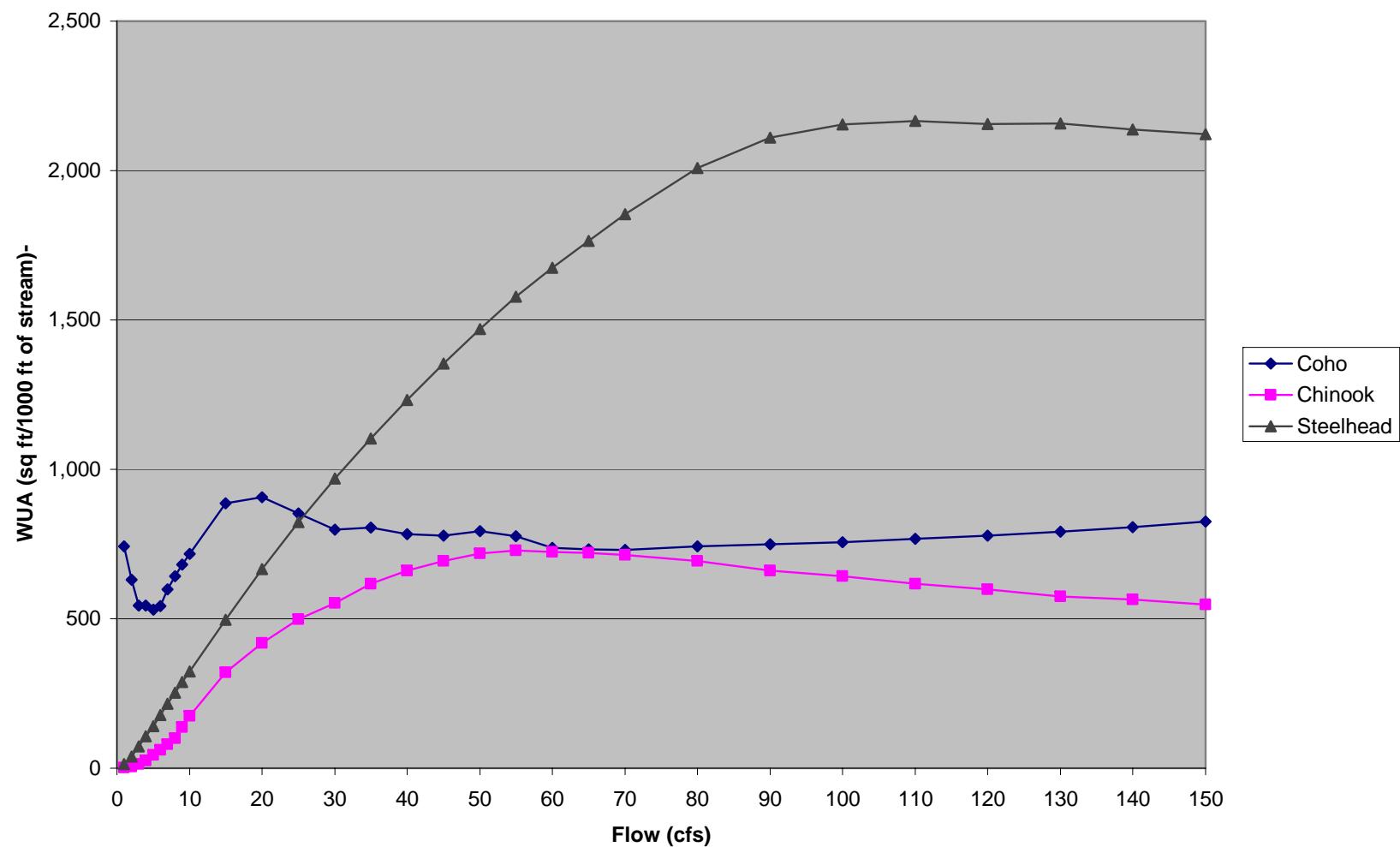
May 2005

Combined Study Sites 1 and 2, Clallam River. Spawning WUA, Transect 1 (riffle)					Combined Study Sites 1 and 2, Clallam River. Rearing WUA, Transects 2 – 4.			
Flow	Coho	Chum	Chinook	Steelhead	Flow	Coho	Chinook	Steelhead
1	4	176	0	0	1	4	176	0
2	25	374	0	0	2	25	374	0
3	74	622	3	0	3	74	622	3
4	126	999	12	0	4	126	999	12
5	186	1,391	43	0	5	186	1,391	43
6	254	1,774	94	2	6	254	1,774	94
7	322	2,160	161	6	7	322	2,160	161
8	402	2,539	239	11	8	402	2,539	239
9	523	2,905	320	24	9	523	2,905	320
10	670	3,277	400	42	10	670	3,277	400
15	1,377	5,263	1,108	178	15	1,377	5,263	1,108
20	2,023	7,342	2,037	425	20	2,023	7,342	2,037
25	2,603	9,507	3,012	890	25	2,603	9,507	3,012
30	3,179	11,681	4,005	1,443	30	3,179	11,681	4,005
35	3,795	13,631	5,061	2,077	35	3,795	13,631	5,061
40	4,350	15,345	6,163	2,767	40	4,350	15,345	6,163
45	4,832	16,828	7,243	3,561	45	4,832	16,828	7,243
50	5,354	18,083	8,318	4,391	50	5,354	18,083	8,318
55	5,837	19,103	9,413	5,286	55	5,837	19,103	9,413
60	6,239	19,957	10,590	6,187	60	6,239	19,957	10,590
65	6,562	20,633	11,752	7,077	65	6,562	20,633	11,752
70	6,786	21,236	12,869	7,951	70	6,786	21,236	12,869
80	7,009	22,066	14,342	9,517	80	7,009	22,066	14,342
90	<b>7,037</b>	22,691	15,449	10,874	90	<b>7,037</b>	22,691	15,449
100	6,961	<b>23,034</b>	16,367	12,150	100	6,961	<b>23,034</b>	16,367
110	6,830	22,906	17,042	13,217	110	6,830	22,906	17,042
120	6,712	21,912	<b>17,340</b>	14,169	120	6,712	21,912	<b>17,340</b>
130	6,559	20,764	17,272	14,919	130	6,559	20,764	17,272
140	6,364	19,706	16,809	15,459	140	6,364	19,706	16,809
150	6,201	18,858	16,148	<b>15,689</b>	150	6,201	18,858	16,148
160				<b>14,646</b>				
170				<b>14,515</b>				
180				<b>14,305</b>				
Max WUA Flow	7,037	23,034	17,340	15,689	7,037	23,034	17,340	
	90	100	120	150	90	100	120	

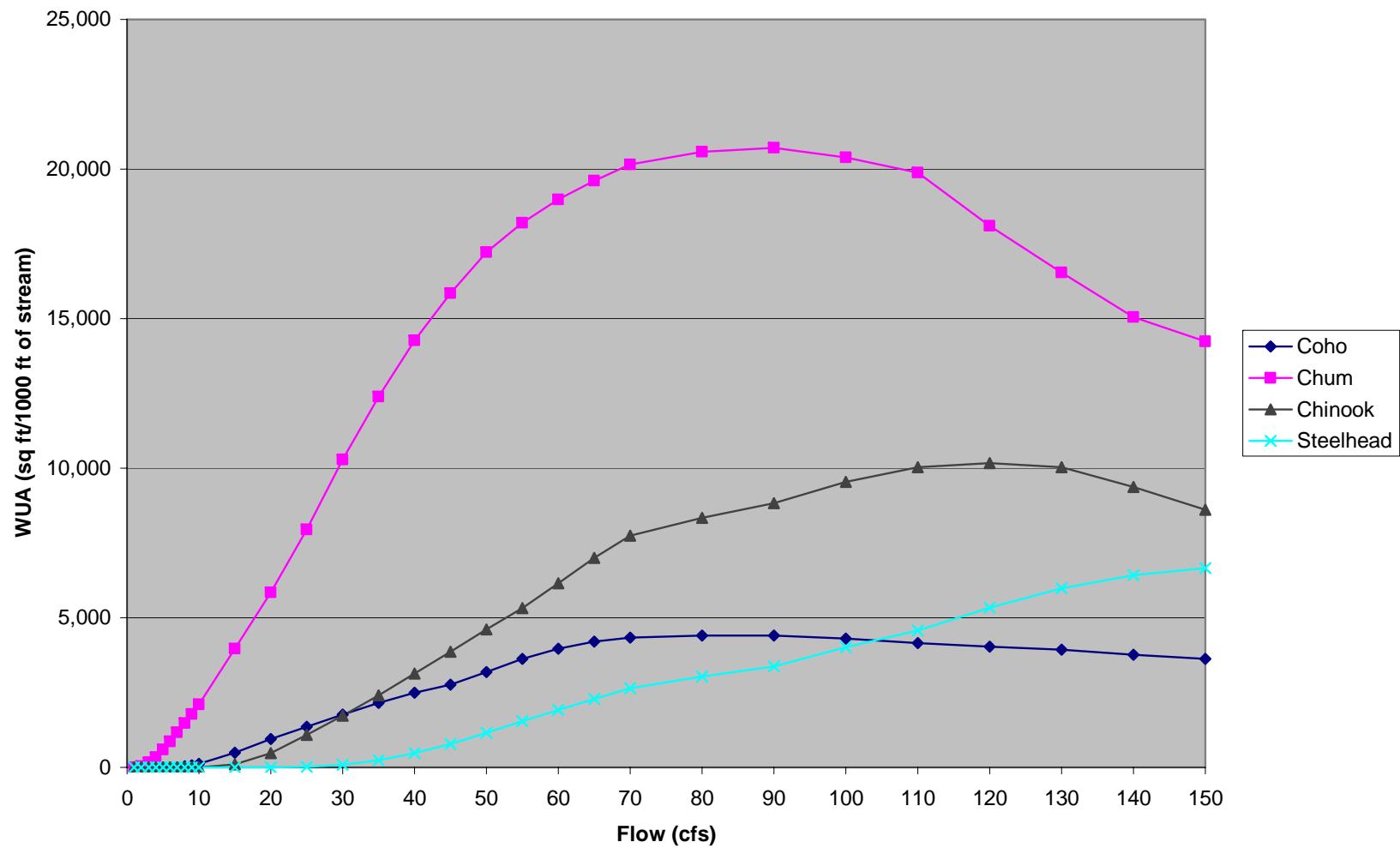
### Clallam River Study Site 1 Spawning WUA - Transect 1



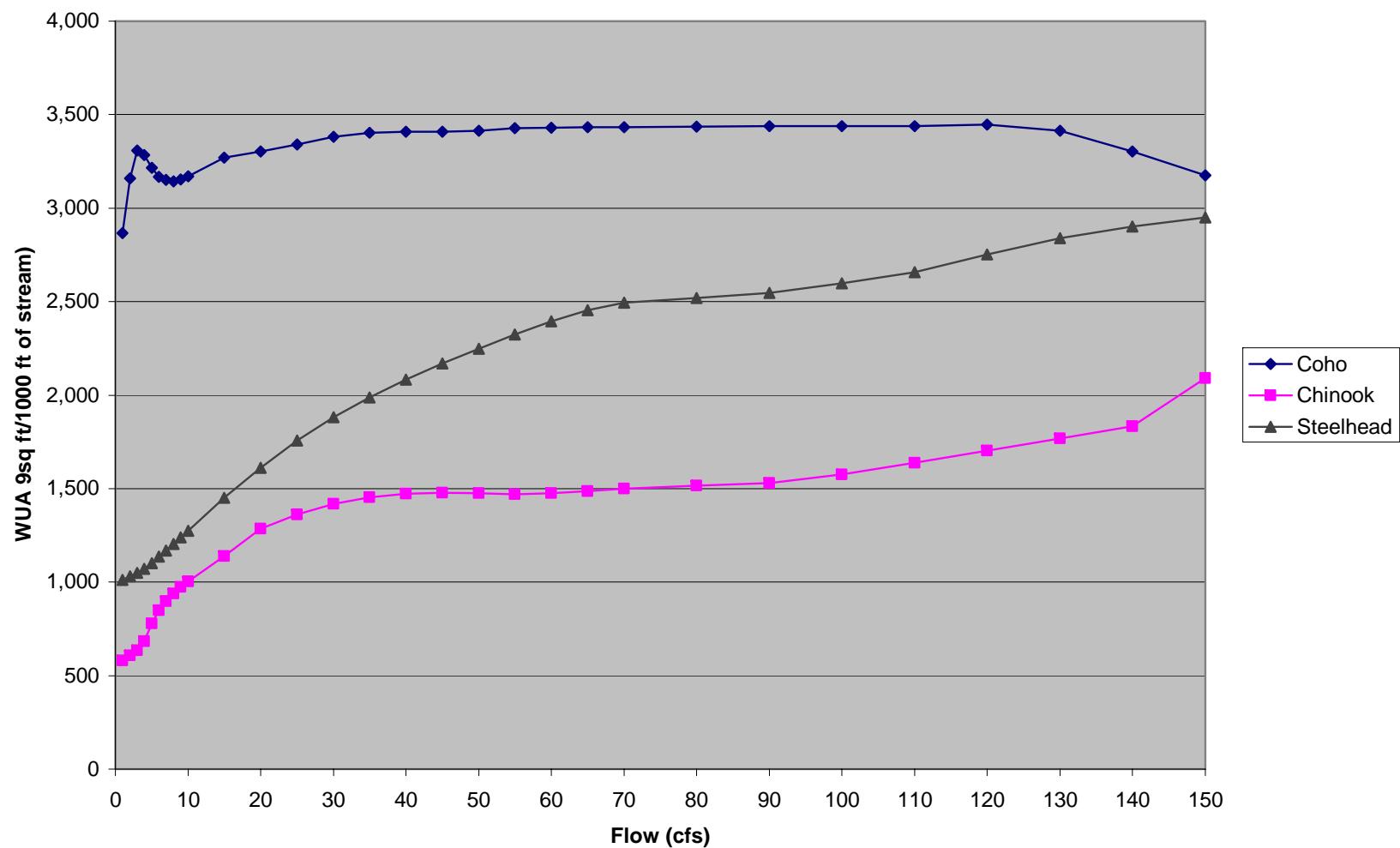
### Clallam River Study Site 1 Rearing WUA - Transects 2 - 4



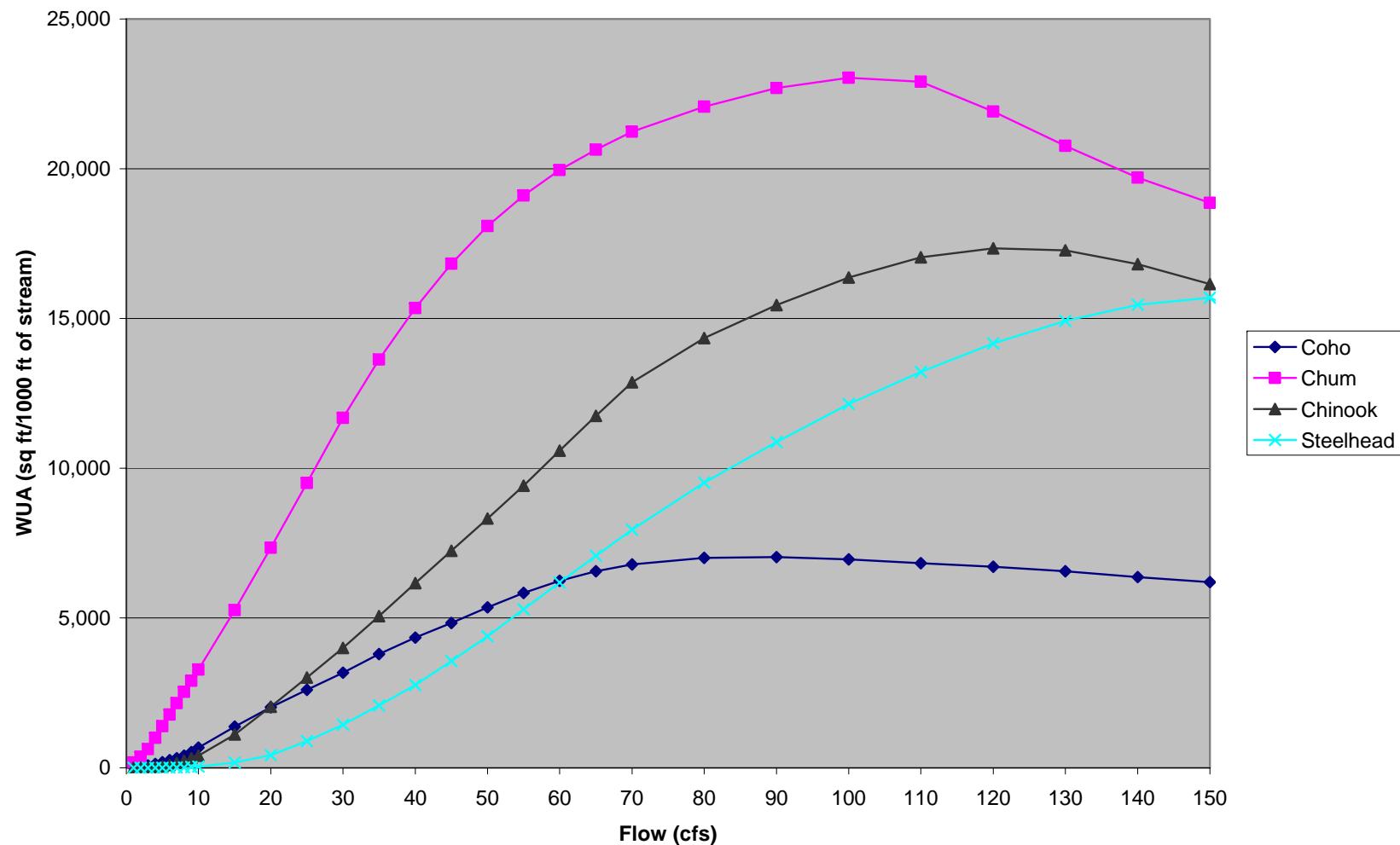
### Clallam River Study Site 2 Spawning WUA - Transect 1



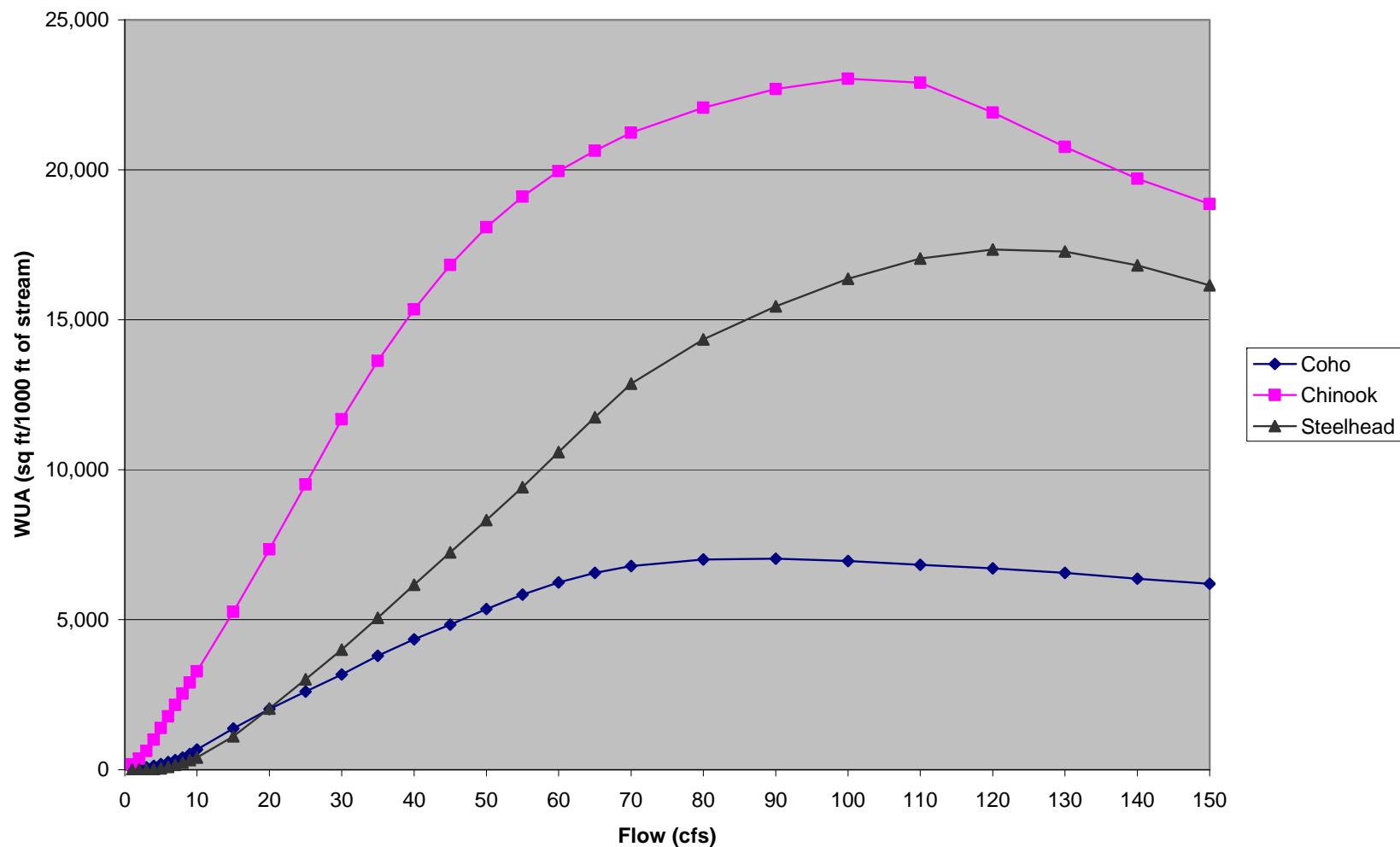
### Clallam River Study Site 2 Rearing WUA Transects 2 - 4



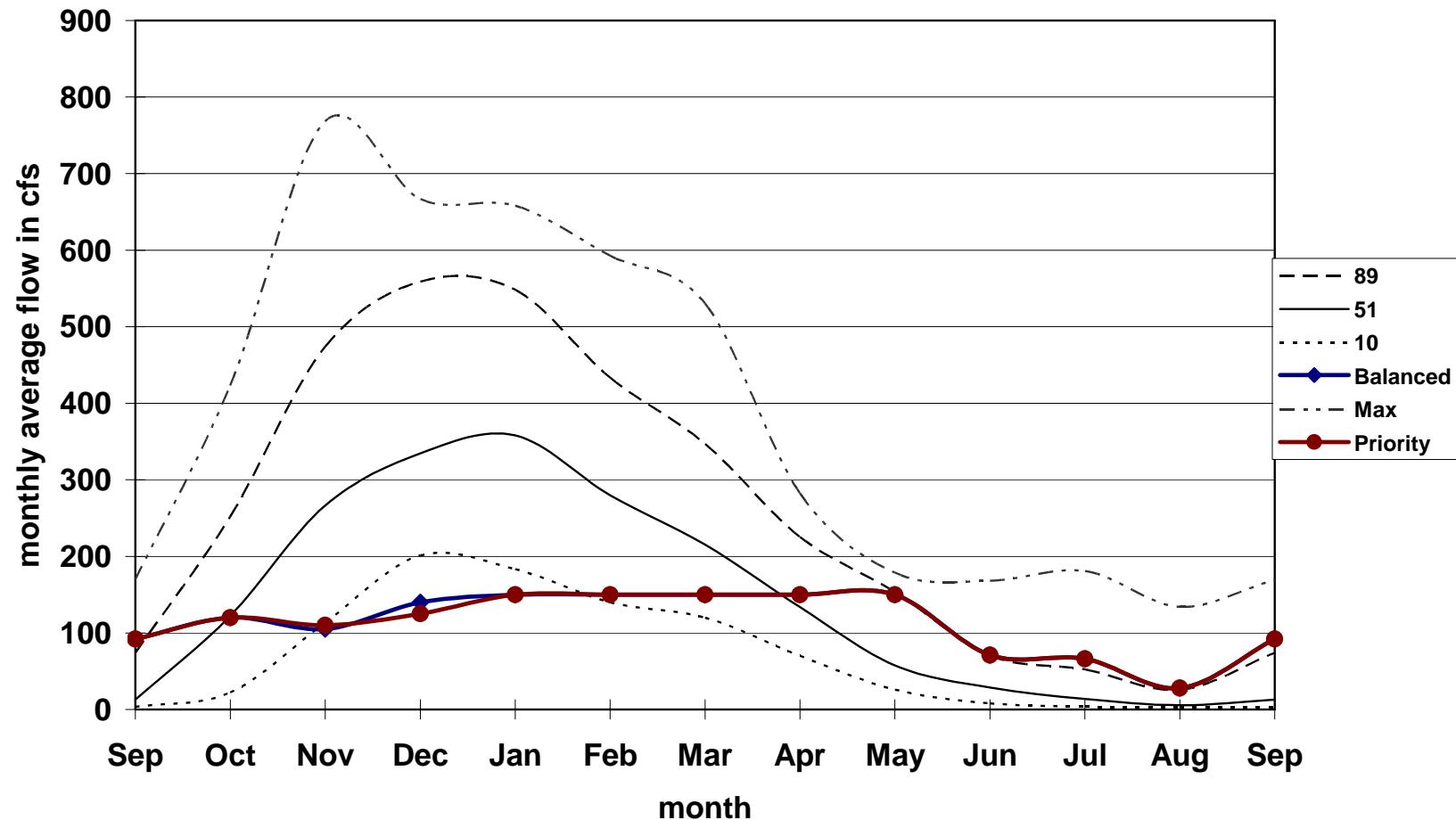
### Clallam River Combined Sites, Spawning WUA - Transects 1



### Clallam River Combined Study Sites - Rearing Transects 2 - 4



**Clallam River at Outlet 1962 - 99**  
**% time flow less than or equal to**



Summary of Flow Recommendations, Clallam River

Max WUA (cfs)

	ChS	CoS	CmS	ShS	CoR	ChR	ShR
SS1	120	90	110	150	20	55	110
SS2	120	80	90	150	120	150	150
Combined	120	90	100	150	90	100	120

Month/Day	Species and Life Stage	Suggested Flows			Hydrology		Comments
		Priority	Balanced	Mn Flow	10% Ex		
Oct 1-15	<b>ChS</b>		120	120	137	276	Max WUA
Oct 15-31	<b>ChS</b>	CoS		120	120	137	276 Max WUA
Nov 1-15	<b>ChS</b>	CoS	CmS	120	110	312	573 Max WUA
Nov 16-30		CoS	<b>CmS</b>	100	100	312	276 Max WUA
Dec 1-15	ShS	CoS	<b>CmS</b>	100	110	357	586 Max WUA
Dec 16-31	<b>ShS</b>	CoS		150	150	357	276 Max WUA
Jan 1-15	<b>ShS</b>	CoS		150	150	359	555 Max WUA
Jan 16-31	<b>ShS</b>			150	150	359	276 Max WUA
Feb	<b>ShS</b>			150	150	287	447 Max WUA
March	<b>ShS</b>	ShR	CoR	ChR	150	150	359 Max WUA
April	<b>ShS</b>	ShR	CoR	ChR	150	150	228 Max WUA
May	<b>ShS</b>	ShR	CoR	ChR	ShE	150	75 157 Max WUA
June		<b>ShR</b>	CoR	ChR	ShE	71	36 71 Max WUA=150
July		<b>ShR</b>	CoR	ChR		66	25 66 Max WUA=150
Aug		<b>ShR</b>	CoR			28	13 28 Max WUA=150
Sept		<b>ShR</b>	CoR			92	31 92 Max WUA=150

*Flow Allocation: 10% median flow, Oct – Mar = 26.2 cfs*

CoR	Coho Rearing	ShR	Steelhead Rearing
CoS	Coho Spawning	ShS	Steelhead Spawning
ChR	Chinook Rearing	ShE	Steelhead Emergence
ChS	Chinook Spawning		
CmS	Chum Spawning		

***Bold = Priority Species***

Combined WUA for Clallam Study Sites 1 and 2, using the balanced approach of averaging WUA for species and life stages								
Flow	ShS/ShR/ CoR/ChR	ShR/ CoR	ChS/ CoS	CoS/ChS/ CmS	CoS/ ChS	ShS/CoS/ CmS	ShS/ CoS	ShR/CoR/ ChR
1	652	1,159	2	60	90	60	2	869
2	684	1,215	13	133	200	133	13	912
3	703	1,244	38	233	348	232	37	937
4	715	1,252	69	379	563	375	63	953
5	726	1,247	114	540	788	525	93	968
6	742	1,255	174	707	1,014	677	128	989
7	765	1,283	242	881	1,241	830	164	1,019
8	788	1,310	320	1,060	1,470	984	207	1,046
9	815	1,340	422	1,249	1,714	1,150	273	1,078
10	843	1,371	535	1,449	1,973	1,330	356	1,110
15	990	1,526	1,243	2,583	3,320	2,273	778	1,261
20	1,130	1,622	2,030	3,801	4,683	3,263	1,224	1,365
25	1,302	1,694	2,808	5,041	6,055	4,334	1,747	1,439
30	1,486	1,758	3,592	6,288	7,430	5,434	2,311	1,501
35	1,690	1,825	4,428	7,496	8,713	6,501	2,936	1,562
40	1,896	1,876	5,256	8,619	9,848	7,487	3,558	1,606
45	2,125	1,927	6,038	9,634	10,830	8,407	4,196	1,647
50	2,362	1,981	6,836	10,585	11,719	9,276	4,872	1,686
55	2,609	2,026	7,625	11,451	12,470	10,075	5,562	1,717
60	2,851	2,059	8,415	12,262	13,098	10,794	6,213	1,739
65	3,093	2,096	9,157	12,982	13,597	11,424	6,819	1,765
70	3,329	2,129	9,828	13,630	14,011	11,991	7,369	1,788
80	3,744	2,177	10,675	14,472	14,537	12,864	8,263	1,820
90	4,098	2,211	11,243	15,059	14,864	13,534	8,955	1,839
100	4,433	2,237	11,664	15,454	<b>14,997</b>	14,048	9,556	1,861
110	4,715	2,257	11,936	<b>15,593</b>	14,868	<b>14,318</b>	10,024	1,881
120	4,971	2,283	<b>12,026</b>	15,321	14,312	14,264	10,440	1,905
130	5,173	<b>2,300</b>	11,916	14,865	13,662	14,081	10,739	1,924
140	5,308	2,287	11,587	14,293	13,035	13,843	10,912	1,924
150	<b>5,386</b>	2,268	11,175	13,736	12,529	13,582	<b>10,945</b>	<b>1,952</b>

# **PYSHT RIVER STUDY COMBINED STUDY SITES INSTREAM FLOW RECOMMENDATIONS**

Prepared for:

**WRIA 19 Planning Unit**

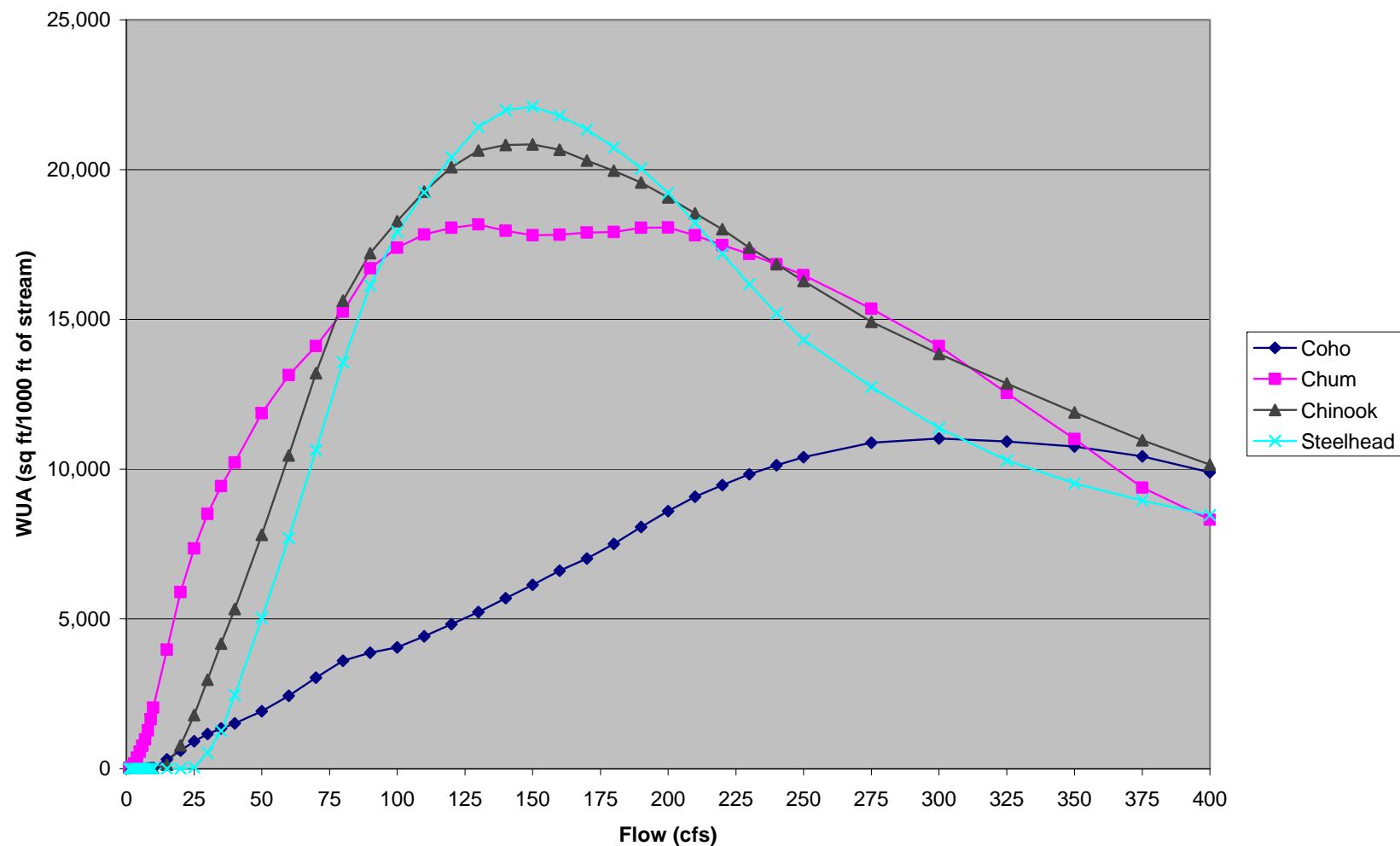
Prepared by:

**EES Consulting**

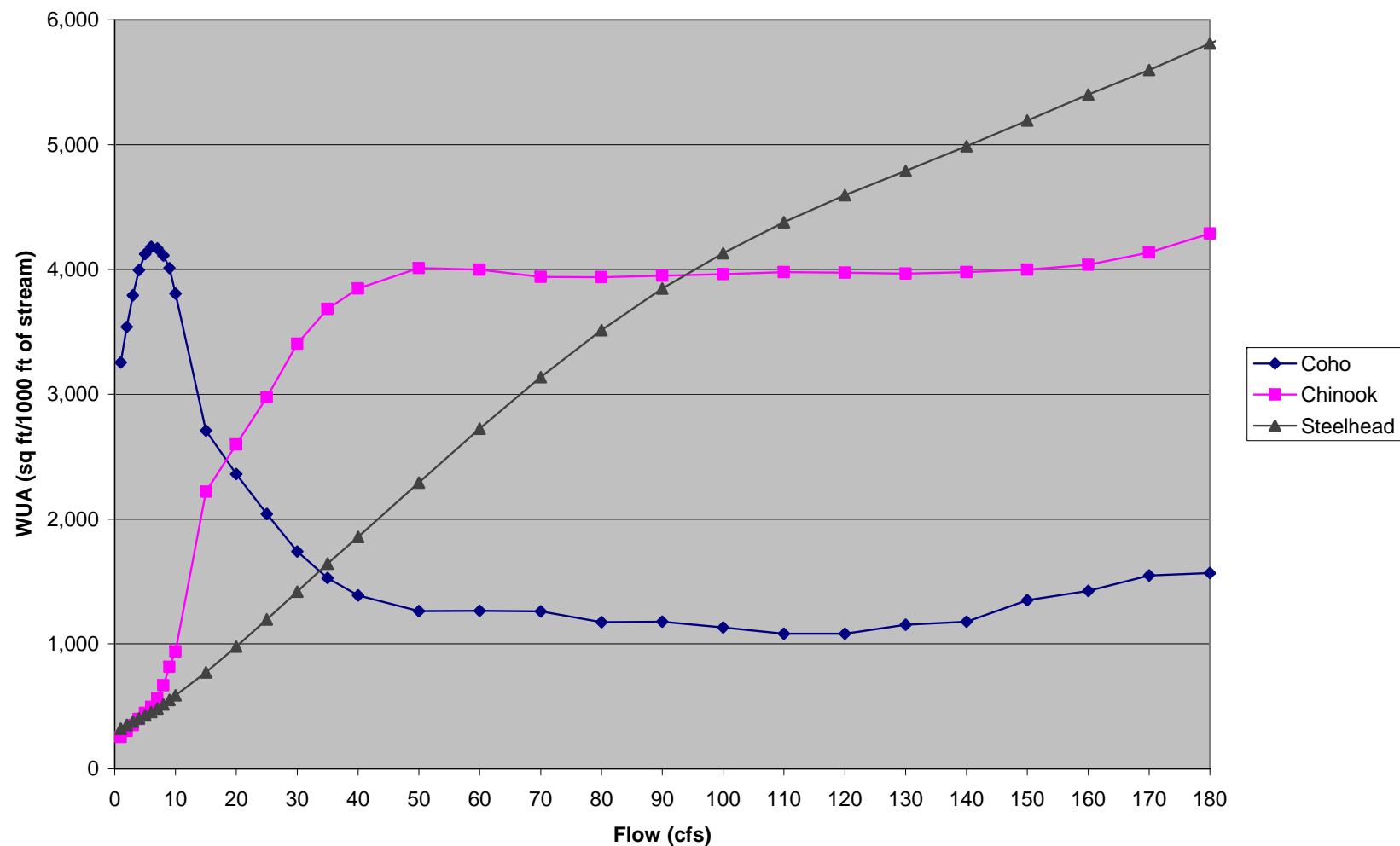
May 2005

Pysht River Study Site 2 Weighted Usable Area					Rearing WUA - Transects 2 - 4			
Spawning WUA – Transect 1 (riffle)								
Flow	Coho	Chum	Chinook	Steelhead	Flow	Coho	Chinook	Steelhead
1	0	27	0	0	1	3,254	254	321
2	0	58	0	0	2	3,539	303	352
3	0	174	0	0	3	3,793	350	378
4	0	371	0	0	4	3,994	398	404
5	0	564	0	0	5	4,124	447	429
6	0	758	0	0	6	4,181	495	456
7	1	976	0	0	7	4,168	562	483
8	14	1,278	0	0	8	4,112	669	516
9	26	1,648	0	0	9	4,011	817	552
10	37	2,038	0	0	10	3,806	939	588
15	312	3,973	134	0	15	2,709	2,220	773
20	605	5,897	786	0	20	2,361	2,598	978
25	918	7,351	1,793	52	25	2,042	2,975	1,197
30	1,164	8,504	2,975	528	30	1,740	3,404	1,418
35	1,344	9,434	4,175	1,260	35	1,529	3,683	1,643
40	1,514	10,227	5,329	2,460	40	1,388	3,847	1,859
50	1,924	11,865	7,812	5,029	50	1,264	4,010	2,293
60	2,435	13,143	10,458	7,700	60	1,265	3,998	2,725
70	3,038	14,105	13,208	10,643	70	1,262	3,940	3,137
80	3,608	15,264	15,629	13,573	80	1,174	3,938	3,513
90	3,871	16,699	17,208	16,130	90	1,179	3,950	3,848
100	4,048	17,397	18,274	17,922	100	1,132	3,962	4,130
110	4,424	17,830	19,264	19,236	110	1,082	3,979	4,378
120	4,830	18,063	20,084	20,406	120	1,081	3,974	4,595
130	5,230	18,165	20,638	21,413	130	1,154	3,966	4,789
140	5,691	17,958	20,821	21,981	140	1,178	3,979	4,988
150	6,141	17,806	20,840	22,099	150	1,350	3,998	5,193
160	6,613	17,826	20,660	21,797	160	1,425	4,037	5,401
170	7,017	17,900	20,299	21,338	170	1,548	4,137	5,598
180	7,502	17,914	19,959	20,736	180	1,569	4,287	5,809
190	8,071	18,060	19,568	20,040	190	1,524	4,421	6,007
200	8,599	18,071	19,073	19,215	200	1,556	4,615	6,181
210	9,079	17,808	18,542	18,223	210	1,515	4,783	6,357
220	9,467	17,479	18,008	17,191	220	1,569	4,939	6,511
230	9,830	17,180	17,398	16,169	230	1,541	5,134	6,677
240	10,132	16,841	16,844	15,204	240	1,593	5,366	6,864
250	10,402	16,473	16,282	14,323	250	1,639	5,636	7,034
275	10,879	15,355	14,915	12,742	275	1,849	6,449	7,503
300	11,025	14,108	13,848	11,375	300	1,963	7,270	7,947
325	10,928	12,538	12,863	10,289	325	2,008	8,159	8,320
350	10,758	11,005	11,894	9,530	350	2,119	8,910	8,777
375	10,426	9,387	10,971	8,952	375	2,286	9,521	9,324
400	9,893	8,312	10,148	8,468	400	2,328	10,175	9,851
Max Flow	11,025 300	18,165 130	20,840 150	22,099 150	Max Flow	4,181 6	10,175 400	9,851 400

### Pysht River Study Site 2 Spawning WUA - Transect 1 (riffle)

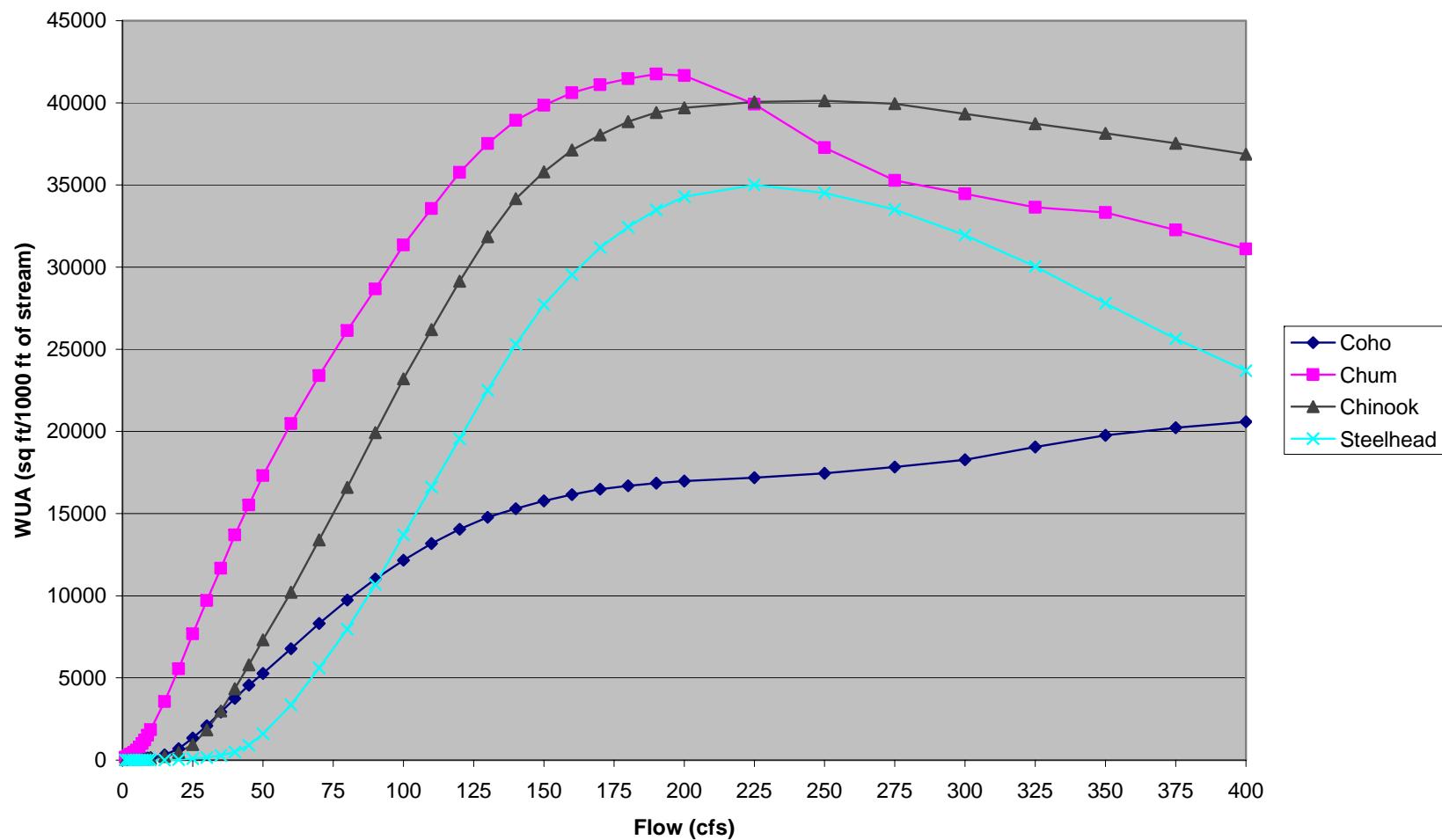


### Pysht River Study Site 2 Rearing WUA Transects 2 - 4

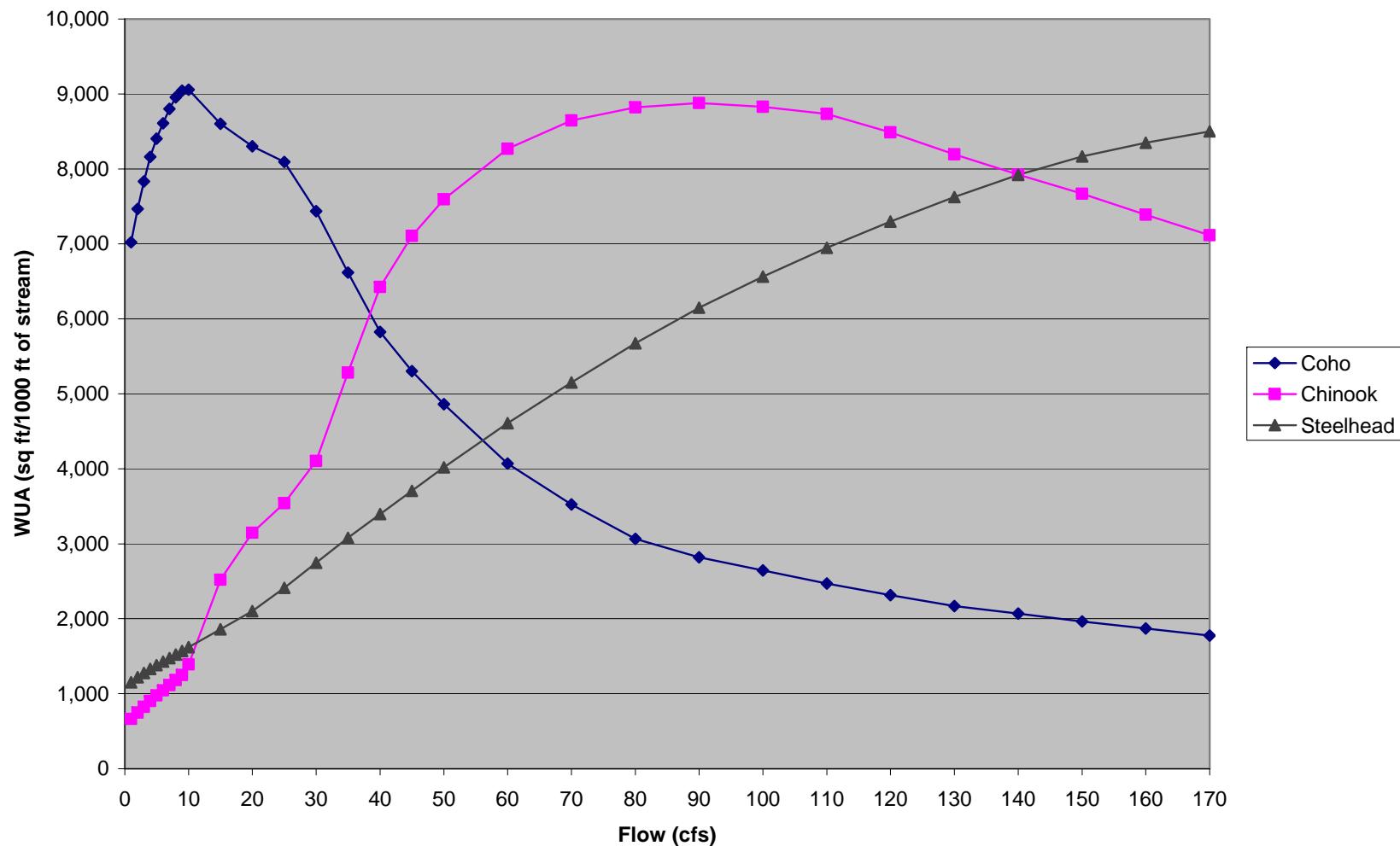


Pysht River Study Site 1 Weighted Usable Area									
Flow	Spawning WUA - Transect 1 (riffle)					Rearing WUA - Transects 2 - 4			
	Coho	Chum	Chinook	Steelhead		Flow	Coho	Chinook	Steelhead
0.9	0	169	0	0		0.9	6,973	654	1,143
1.8	0	246	0	0		1.8	7,386	732	1,207
2.8	3	331	0	0		2.8	7,763	812	1,267
3.8	29	438	0	0		3.8	8,102	888	1,321
4.7	52	560	0	0		4.7	8,336	954	1,367
5.7	73	737	2	0		5.7	8,548	1,025	1,415
6.7	92	941	21	0		6.7	8,745	1,094	1,461
7.6	107	1,134	41	0		7.6	8,905	1,155	1,502
8.6	124	1,393	63	0		8.6	9,023	1,223	1,550
13.4	245	3,010	176	0		13.4	8,763	2,214	1,786
18.2	535	4,833	355	4		18.2	8,388	2,960	2,010
23.1	1,053	6,875	717	70		23.1	8,198	3,410	2,288
27.9	1,792	8,869	1,381	135		27.9	7,738	3,780	2,607
32.7	2,532	10,758	2,457	228		32.7	7,021	4,700	2,929
37.6	3,347	12,761	3,641	380		37.6	6,174	5,945	3,245
42.4	4,152	14,581	5,041	683		42.4	5,551	6,801	3,546
47.2	4,886	16,324	6,468	1,165		47.2	5,093	7,366	3,845
56.9	6,302	19,539	9,317	2,731		56.9	4,266	8,121	4,431
66.5	7,782	22,355	12,279	4,785		66.5	3,699	8,571	4,965
76.2	9,221	25,157	15,371	7,071		76.2	3,211	8,774	5,480
85.8	10,543	27,713	18,569	9,531		85.8	2,907	8,862	5,960
95.5	11,697	30,287	21,823	12,416		95.5	2,714	8,870	6,381
105.1	12,687	32,502	24,748	15,197		105.1	2,551	8,788	6,764
114.8	13,627	34,667	27,631	18,017		114.8	2,394	8,641	7,122
124.4	14,371	36,566	30,380	20,877		124.4	2,245	8,368	7,444
134.1	15,011	38,134	32,831	23,671		134.1	2,129	8,077	7,750
143.7	15,497	39,303	34,812	26,218		143.7	2,029	7,837	8,018
153.4	15,916	40,153	36,316	28,384		153.4	1,930	7,567	8,234
163.1	16,265	40,789	37,432	30,083		163.1	1,841	7,303	8,401
172.7	16,558	41,202	38,263	31,550		172.7	1,749	7,040	8,531
182.4	16,730	41,575	39,033	32,696		182.4	1,642	6,782	8,595
192	16,883	41,755	39,485	33,691		192	1,552	6,511	8,635
216.1	17,114	40,698	39,968	35,002		216.1	1,351	5,842	8,646
240.3	17,347	38,305	40,110	34,821		240.3	1,189	5,120	8,600
264.4	17,644	35,874	40,090	33,964		264.4	1,128	4,433	8,531
288.5	18,077	34,770	39,634	32,714		288.5	1,101	3,851	8,441
312.7	18,590	34,002	38,995	31,036		312.7	996	3,396	8,314
336.8	19,419	33,533	38,457	28,986		336.8	864	3,007	8,039
360.9	19,998	32,893	37,896	26,816		360.9	747	2,643	7,696
385.1	20,374	31,798	37,263	24,872		385.1	684	2,335	7,382

### Pysht River Study Site 1 Spawning WUA Transect 1 - Riffle



### Pysht River Study Site 1 Rearing WUA Transects 2 - 4



**Regression analysis of flows relating  
Pysht SS1 (upstream) to SS2  
(downstream).**

$$SS1 = 0.965347 * SS2 - 1.05781$$

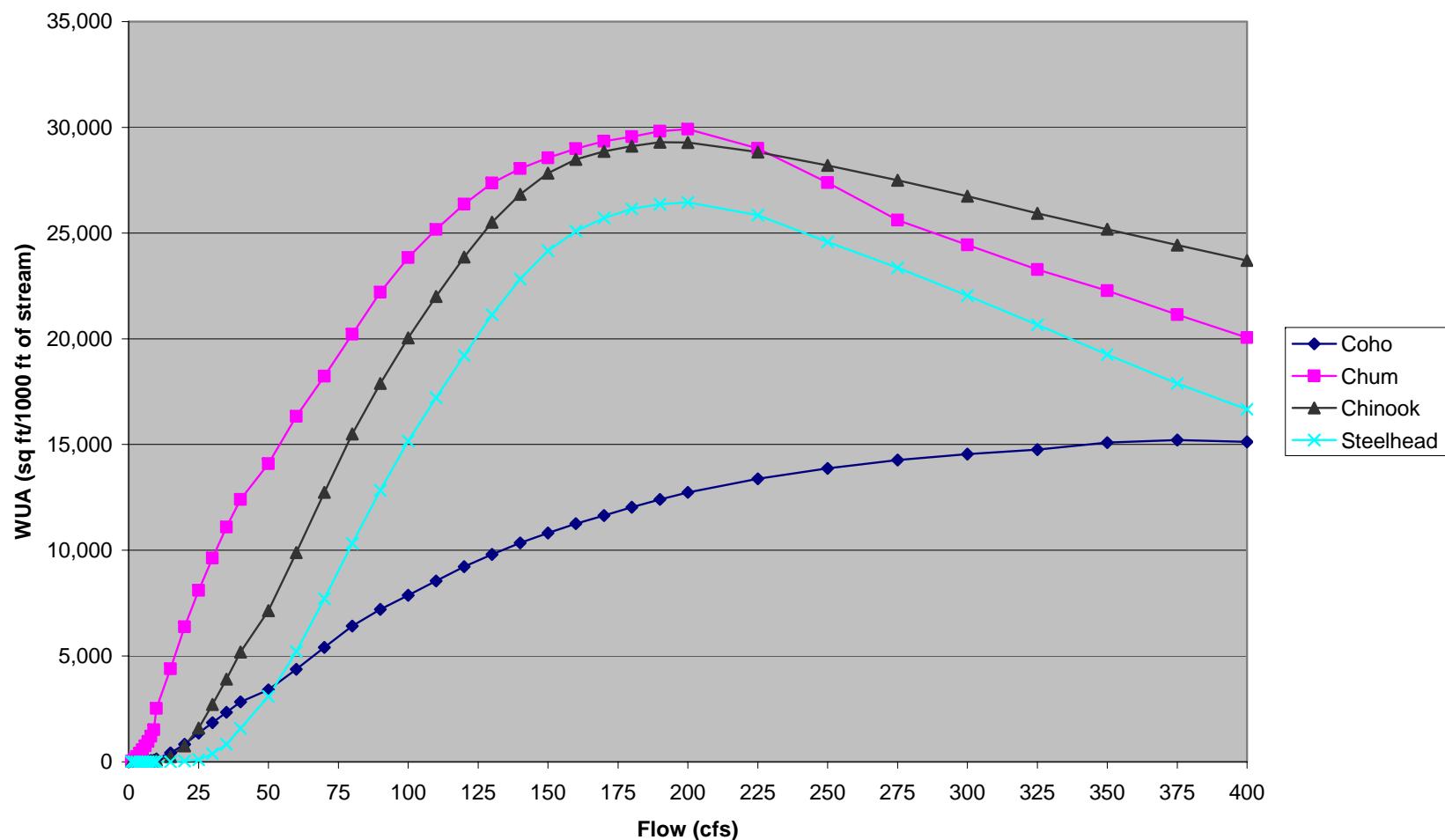
$$r^2 = 0.99969$$

Flow (cfs)	
SS2	SS1
1	-0.1
2	0.9
3	1.8
4	2.8
5	3.8
6	4.7
7	5.7
8	6.7
9	7.6
10	8.6
15	13.4
20	18.2
25	23.1
30	27.9
35	32.7
40	37.6
45	42.4
50	47.2
60	56.9
70	66.5
80	76.2
90	85.8
100	95.5
110	105.1
120	114.8
130	124.4
140	134.1
150	143.7
160	153.4
170	163.1
180	172.7
190	182.4
200	192.0
225	216.1
250	240.3
275	264.4
300	288.5
325	312.7
350	336.8
375	360.9
400	385.1

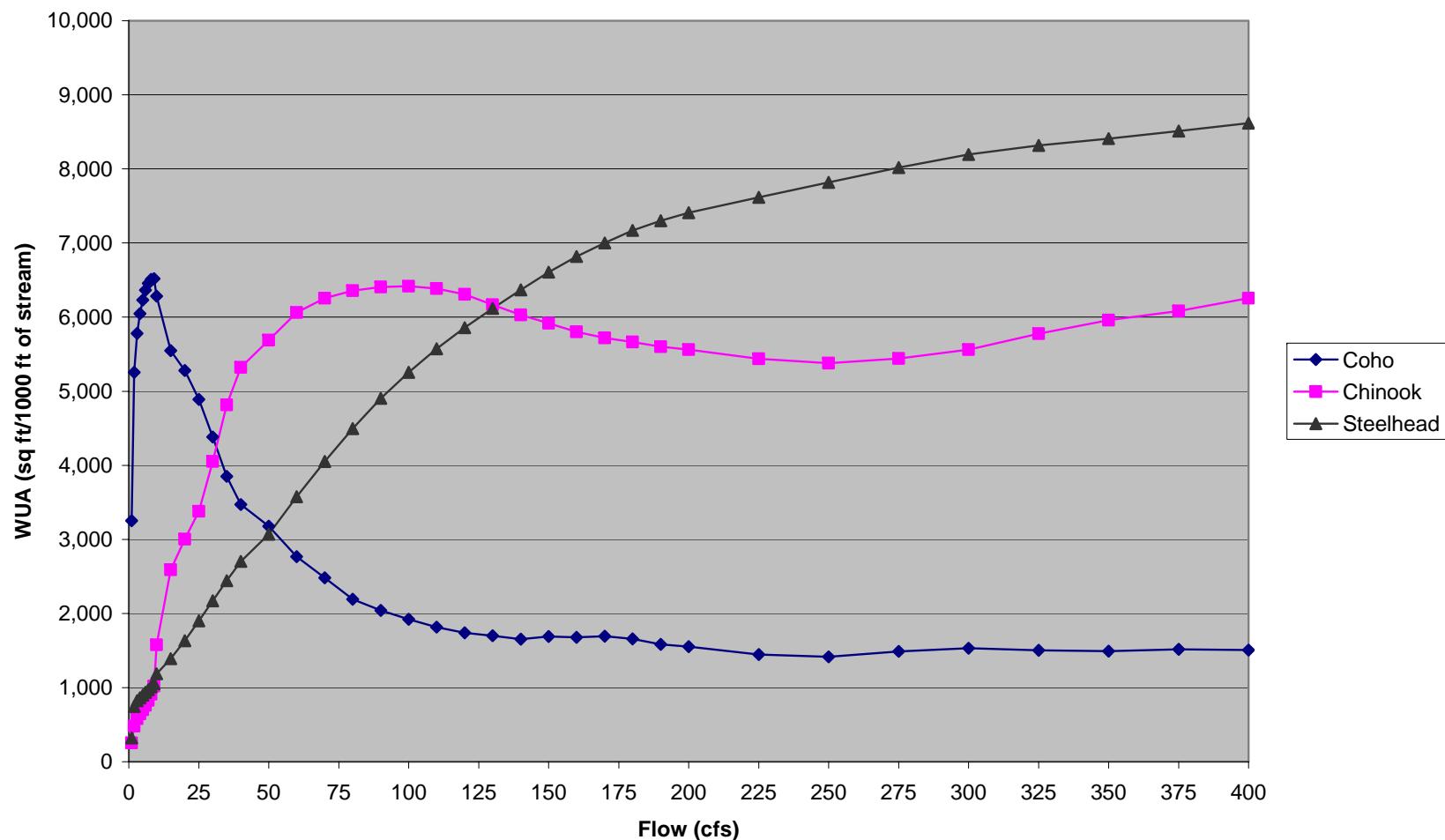
**Pysht River Weighted Usable Area, Combined Study Sites 1 and 2. Flows as Measured at the Lower Site.**

Flow	Coho	Chum	Chinook	Steelhead	Flow	Coho	Chinook	Steelhead
1	0	27	0	0	1	3,254	254	321
2	0	113	0	0	2	5,256	478	747
3	2	252	0	0	3	5,778	581	823
4	14	404	0	0	4	6,048	643	862
5	26	562	0	0	5	6,230	700	898
6	37	748	1	0	6	6,365	760	935
7	46	959	10	0	7	6,457	828	972
8	61	1,206	21	0	8	6,509	912	1,009
9	75	1,521	32	0	9	6,517	1,020	1,051
10	141	2,524	88	0	10	6,284	1,577	1,187
15	423	4,403	245	2	15	5,549	2,590	1,392
20	829	6,386	751	35	20	5,280	3,004	1,633
25	1,355	8,110	1,587	94	25	4,890	3,377	1,902
30	1,848	9,631	2,716	378	30	4,381	4,052	2,173
35	2,346	11,098	3,908	820	35	3,851	4,814	2,444
40	2,833	12,404	5,185	1,571	40	3,469	5,324	2,702
50	3,405	14,094	7,140	3,097	50	3,179	5,688	3,069
60	4,369	16,341	9,888	5,216	60	2,765	6,060	3,578
70	5,410	18,230	12,744	7,714	70	2,480	6,256	4,051
80	6,414	20,211	15,500	10,322	80	2,192	6,356	4,496
90	7,207	22,206	17,888	12,831	90	2,043	6,406	4,904
100	7,873	23,842	20,048	15,169	100	1,923	6,416	5,255
110	8,556	25,166	22,006	17,216	110	1,816	6,384	5,571
120	9,228	26,365	23,857	19,212	120	1,737	6,307	5,858
130	9,801	27,365	25,509	21,145	130	1,699	6,167	6,117
140	10,351	28,046	26,826	22,826	140	1,654	6,028	6,369
150	10,819	28,555	27,826	24,159	150	1,690	5,918	6,605
160	11,265	28,990	28,488	25,090	160	1,678	5,802	6,817
170	11,641	29,345	28,865	25,710	170	1,694	5,720	6,999
180	12,030	29,558	29,111	26,143	180	1,659	5,663	7,170
190	12,400	29,817	29,300	26,368	190	1,583	5,602	7,301
200	12,741	29,913	29,279	26,453	200	1,554	5,563	7,408
225	13,381	29,004	28,833	25,850	225	1,448	5,440	7,617
250	13,874	27,389	28,196	24,572	250	1,414	5,378	7,817
275	14,261	25,615	27,503	23,353	275	1,488	5,441	8,017
300	14,551	24,439	26,741	22,045	300	1,532	5,560	8,194
325	14,759	23,270	25,929	20,662	325	1,502	5,778	8,317
350	15,088	22,269	25,176	19,258	350	1,492	5,958	8,408
375	15,212	21,140	24,434	17,884	375	1,517	6,082	8,510
400	15,134	20,055	23,706	16,670	400	1,506	6,255	8,617

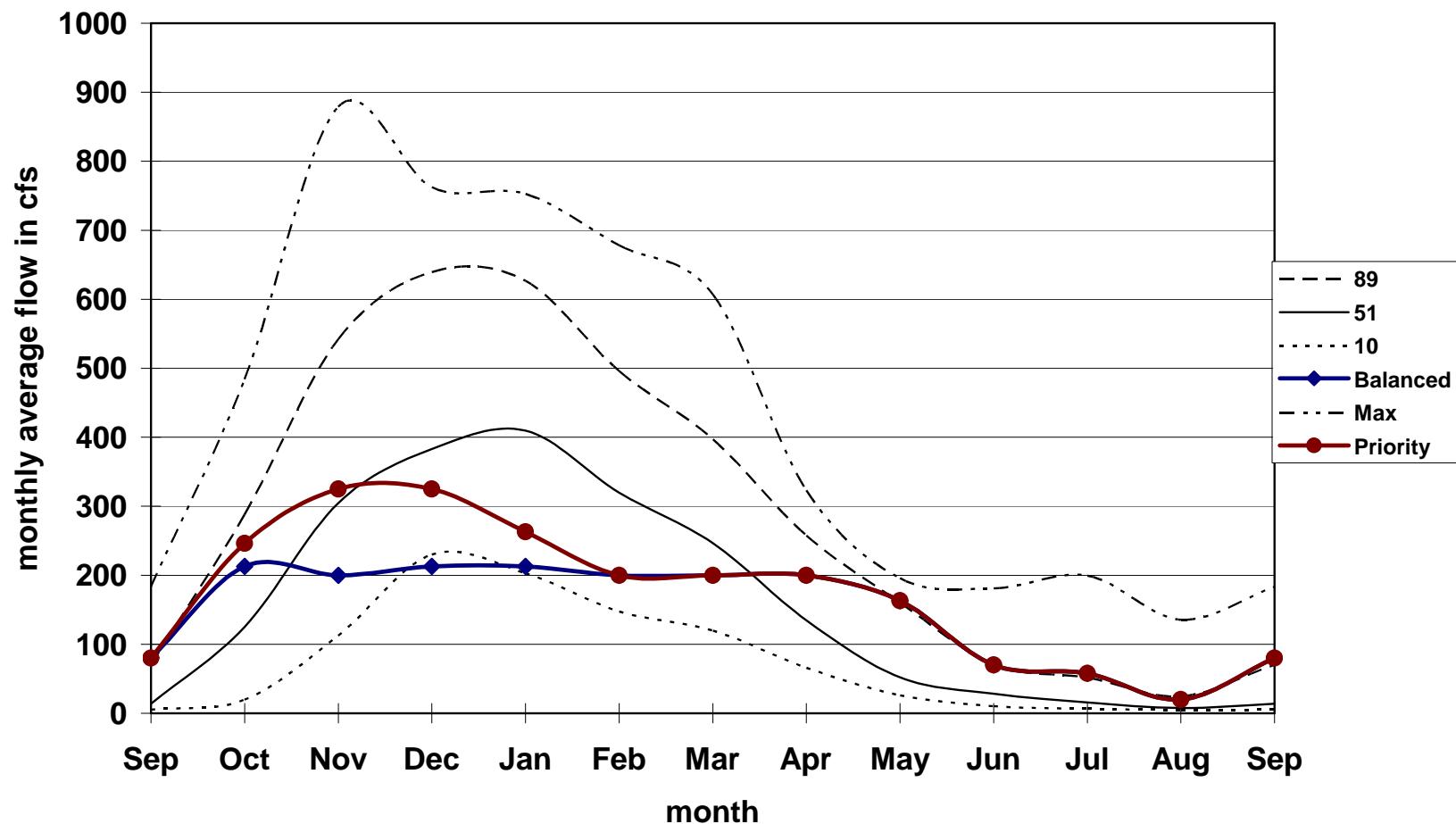
**Pysht River Spawning WUA - Combined Sites, Transect 1 - Riffles.  
Flow As Measured at Lower Site**



**Pysht River Rearing - Combined Sites, Transects 2 - 4.  
Flow as Measured at the Lower Site**



Pysht River at Outlet 1962 - 99  
% time flow less than or equal to



**Summary of Suggested Flows for Pysht River (Study Sites 1 and 2 Combined)**

	ChS	CoS	CmS	ShS	CoR	ChR	ShR
SS1	250	400	190	225	10	90	200
SS2	150	300	130	150	6	400	400
Comb	190	325	200	200	9	100	400

Month/Days	Species and Life Stage				Suggested Flows		Hydrology (cfs)		Comments
					Priority	Balanced	Mean	10 Exc	
Oct 1-15	ShR	CoR	<b>ChS</b>		190	200	150	302	Max Bal 200
Oct 15-31	ChS	<b>CoS</b>			302	225	150	302	Max Bal 225
Nov 1-15	ChS	<b>CoS</b>	CmS		325	200	354	599	Max Bal 200
Nov 16-30	<b>CoS</b>	CmS			325	200	354	599	Max Bal 200
Dec 1-15	<b>CoS</b>	CmS	ShS		325	200	408	655	Max Bal 200
Dec 16-31	<b>CoS</b>	ShS			325	225	408	655	Max Bal 225
Jan 1-15	<b>CoS</b>	ShS			325	225	409	631	Max Bal 225
Jan 16-31	<b>ShS</b>				200	200	409	631	Max Bal 200
Feb	<b>ShS</b>				200	200	325	503	Max Bal 200
March	<b>ShS</b>	ShR	CoR	ChR	200	200	258	404	Max Bal 200
April	<b>ShS</b>	ShR	CoR	ChR	200	200	156	259	Max Bal 200
May	<b>ShS</b>	ShR	CoR	ChR	ShE	163	163	163	Max Bal 200
June	<b>ShR</b>	CoR	ChR	ShE	71	71	37	71	Max Bal 400
July	<b>ShR</b>	CoR	ChR		58	58	27	58	Max Bal 400
Aug	<b>ShR</b>	CoR			26	26	15	26	Max Bal 400
Sept	<b>ShR</b>	CoR			80	80	32	80	Max Bal 400
<b>Flow Allocation: 10% of Median Flow Nov - March = 33.2 cfs</b>									
CoR	Coho Rearing			ShR	Steelhead Rearing				
CoS	Coho Spawning			ShS	Steelhead Spawning				
Chr	Chinook Rearing			ShE	Steelhead Emergence				
ChS	Chinook Spawning				<b>Bold = Priority Species</b>				
CmS	Chum Spawning								

Pysht River Combined Study Sites WUA, using the balanced approach of averaging WUA for species and life stages.									
Flow	ShR/CoR/ ChS	ChS/CoS/	ChS/CoS/ CmS	CoS/Cms	CoS/CmS/ ShS	CoS/ShS	ShS/ShR/ CoR/ChR	ShR/CoR/ ChR	ShR/CoR
1	1,192	0	9	14	9	0	957	1,276	1,788
2	2,001	0	38	57	38	0	1,620	2,161	3,002
3	2,200	1	85	127	85	1	1,795	2,394	3,300
4	2,303	7	140	209	140	7	1,888	2,518	3,455
5	2,376	13	196	294	196	13	1,957	2,609	3,564
6	2,434	19	262	392	261	18	2,015	2,687	3,650
7	2,480	28	338	502	335	23	2,064	2,752	3,714
8	2,513	41	429	633	422	30	2,107	2,810	3,759
9	2,533	53	542	798	532	37	2,147	2,863	3,784
10	2,520	114	918	1,333	888	71	2,262	3,016	3,736
15	2,395	334	1,690	2,413	1,610	213	2,383	3,177	3,470
20	2,555	790	2,655	3,607	2,417	432	2,488	3,305	3,456
25	2,793	1,471	3,684	4,733	3,186	724	2,566	3,390	3,396
30	3,090	2,282	4,732	5,740	3,952	1,113	2,746	3,535	3,277
35	3,401	3,127	5,784	6,722	4,754	1,583	2,982	3,703	3,148
40	3,786	4,009	6,807	7,619	5,603	2,202	3,267	3,832	3,086
50	4,463	5,273	8,213	8,750	6,865	3,251	3,758	3,979	3,124
60	5,410	7,128	10,199	10,355	8,642	4,792	4,405	4,134	3,171
70	6,425	9,077	12,128	11,820	10,451	6,562	5,125	4,262	3,266
80	7,396	10,957	14,042	13,313	12,316	8,368	5,842	4,348	3,344
90	8,278	12,548	15,767	14,707	14,081	10,019	6,546	4,451	3,473
100	9,076	13,960	17,254	15,857	15,628	11,521	7,191	4,531	3,589
110	9,798	15,281	18,576	16,861	16,979	12,886	7,747	4,590	3,694
120	10,484	16,543	19,817	17,797	18,268	14,220	8,279	4,634	3,798
130	11,108	17,655	20,892	18,583	19,437	15,473	8,782	4,661	3,908
140	11,616	18,589	21,741	19,198	20,408	16,588	9,219	4,684	4,011
150	12,040	19,322	22,400	19,687	21,177	17,489	9,593	4,738	4,147
160	12,328	19,876	22,914	20,127	21,781	18,177	9,847	4,766	4,248
170	12,520	20,253	23,284	20,493	22,232	18,676	10,031	4,804	4,347
180	12,647	20,571	23,567	20,794	22,577	19,087	10,159	4,831	4,415

<b>Pysht River Combined Study Sites WUA, using the balanced approach of averaging WUA for species and life stages.</b>									
Flow	ShR/CoR/ ChS		ChS/CoS/ CmS		CoS/CmS/ ShS		ShS/ShR/ CoR/ChR	ShR/CoR/ ChR	ShR/CoR
	ChS	ChS/CoS	CmS	CoS/CmS	ShS	CoS/ShS			
190	12,728	20,850	23,839	21,109	22,862	19,384	10,213	4,828	4,442
200	12,747	21,010	23,978	21,327	23,036	19,597	10,245	4,842	4,481
225	12,633	21,107	23,739	21,193	22,745	19,616	10,089	4,835	4,533
250	12,476	21,035	23,153	20,632	21,945	19,223	9,795	4,870	4,615
275	12,336	20,882	22,460	19,938	21,076	18,807	9,575	4,982	4,753
300	12,155	20,646	21,910	19,495	20,345	18,298	9,333	5,095	4,863
325	11,916	20,344	21,319	19,015	19,564	17,711	9,065	5,199	4,909
350	11,692	20,132	20,844	18,679	18,872	17,173	8,779	5,286	4,950
375	11,487	19,823	20,262	18,176	18,079	16,548	8,498	5,370	5,013
400	11,276	19,420	19,632	17,594	17,286	15,902	8,262	5,459	5,061

**DEEP CREEK**

**INSTREAM FLOW RECOMMENDATIONS**

Prepared for:

**WRIA 19 Planning Unit**

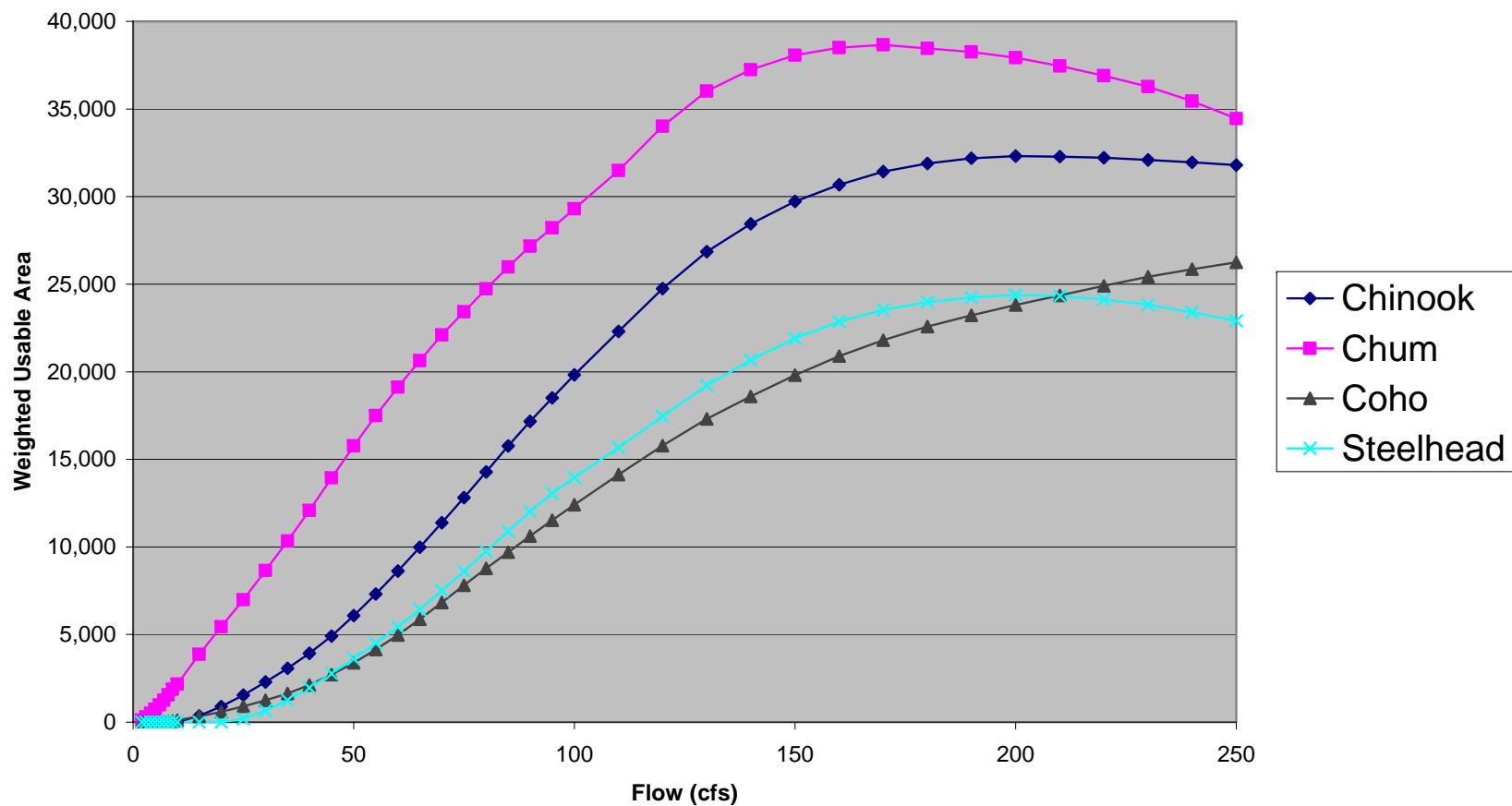
Prepared by:

**EES Consulting**

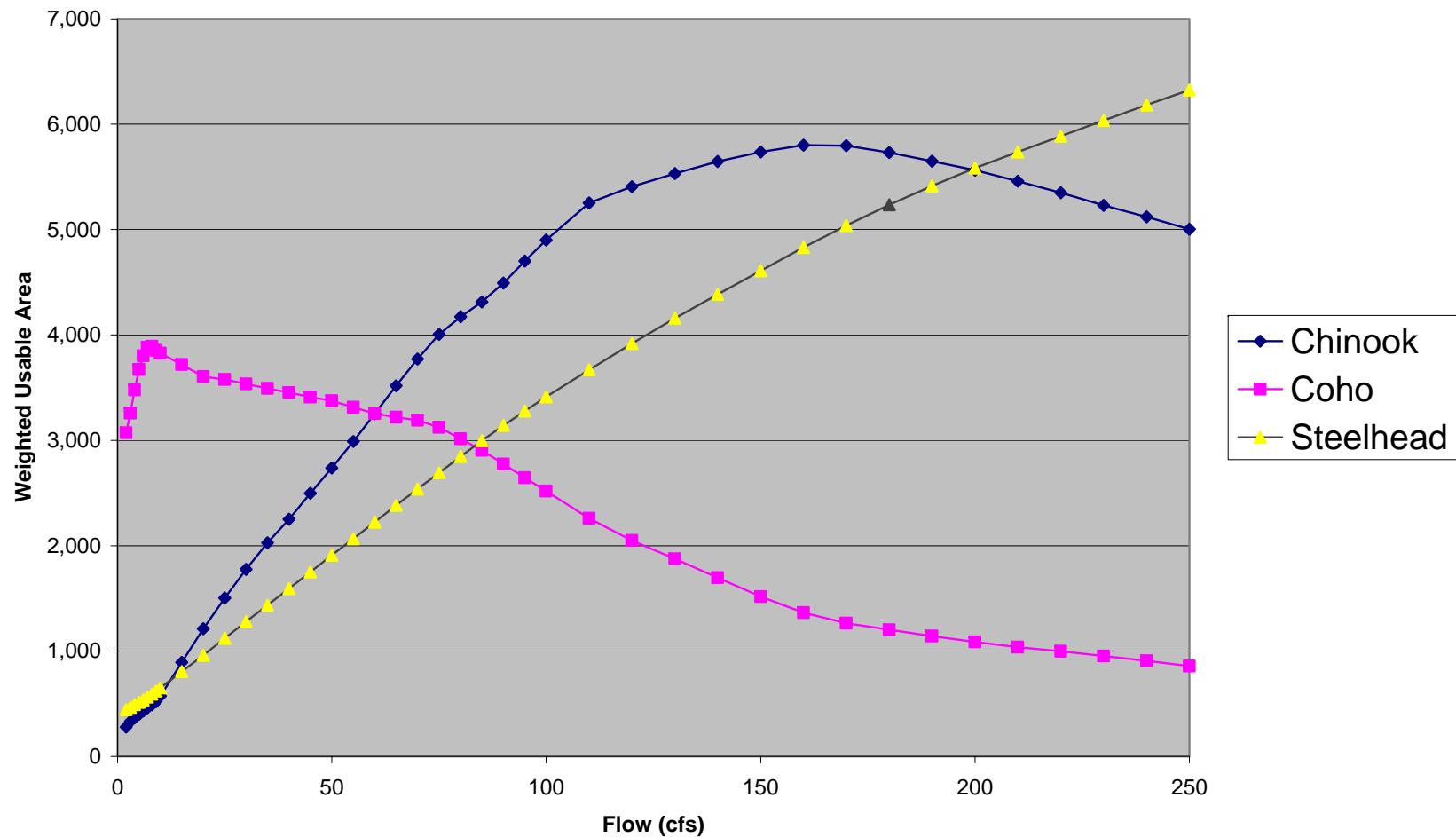
May 2005

Final Deep Creek Spawning - Trans 1 (riffle)					Final Deep Creek Rearing - Transects 2 - 4			
Flow	Coho	Chum	Chinook	Steelhead	Flow	Coho	Chinook	Steelhead
1	0	4	0	0	1	3,071	279	443
2	0	115	0	0	2	3,259	331	467
3	0	291	0	0	3	3,477	367	490
4	0	506	0	0	4	3,672	399	513
5	0	740	0	0	5	3,802	430	537
10	102	2,172	2	0	10	3,881	460	564
15	334	3,867	360	0	15	3,890	488	591
20	590	5,445	893	0	20	3,854	519	621
25	908	6,981	1,537	186	25	3,828	573	651
30	1,240	8,653	2,295	660	30	3,719	893	806
35	1,637	10,343	3,066	1,243	35	3,604	1,210	960
40	2,128	12,093	3,930	1,957	40	3,578	1,503	1,122
45	2,716	13,934	4,912	2,775	45	3,534	1,776	1,280
50	3,381	15,759	6,083	3,620	50	3,494	2,028	1,436
55	4,141	17,497	7,319	4,514	55	3,452	2,250	1,593
60	4,971	19,118	8,617	5,432	60	3,409	2,497	1,751
65	5,879	20,638	9,982	6,431	65	3,376	2,737	1,909
70	6,832	22,090	11,384	7,496	70	3,314	2,990	2,066
75	7,809	23,417	12,812	8,611	75	3,253	3,253	2,222
80	8,779	24,727	14,279	9,743	80	3,219	3,516	2,382
90	10,612	27,163	17,173	12,031	90	3,190	3,771	2,539
100	12,415	29,310	19,818	13,961	100	3,122	4,006	2,693
110	14,126	31,481	22,298	15,673	110	3,015	4,172	2,847
120	15,732	33,503	24,499	17,227	120	2,903	4,313	2,996
130	17,288	35,308	26,490	18,574	130	2,775	4,492	3,140
140	18,646	36,851	28,292	19,835	140	2,644	4,702	3,278
150	19,916	38,030	29,762	20,915	150	2,518	4,901	3,412
160	20,741	38,400	30,343	22,289	160	1,811	5,526	4,250
170	21,675	38,658	31,115	22,890	170	1,657	5,601	4,479
180	22,505	38,557	31,608	23,274	180	1,539	5,632	4,697
190	22,708	37,782	31,308	24,162	190	1,142	5,650	5,414
200	23,279	37,477	31,395	24,232	200	1,086	5,565	5,583
210	23,830	37,013	31,367	24,159	210	1,037	5,460	5,736
220	24,371	36,455	31,289	23,939	220	997	5,349	5,887
230	24,867	35,848	31,165	23,586	230	953	5,229	6,036
240	25,304	35,022	31,027	23,149	240	907	5,120	6,183
250	25,684	34,057	30,846	22,697	250	857	5,002	6,324
Max Flow	25,684	38,658	31,608	24,232		3,890	5,650	6,324
	250	170	180	200		15	190	250

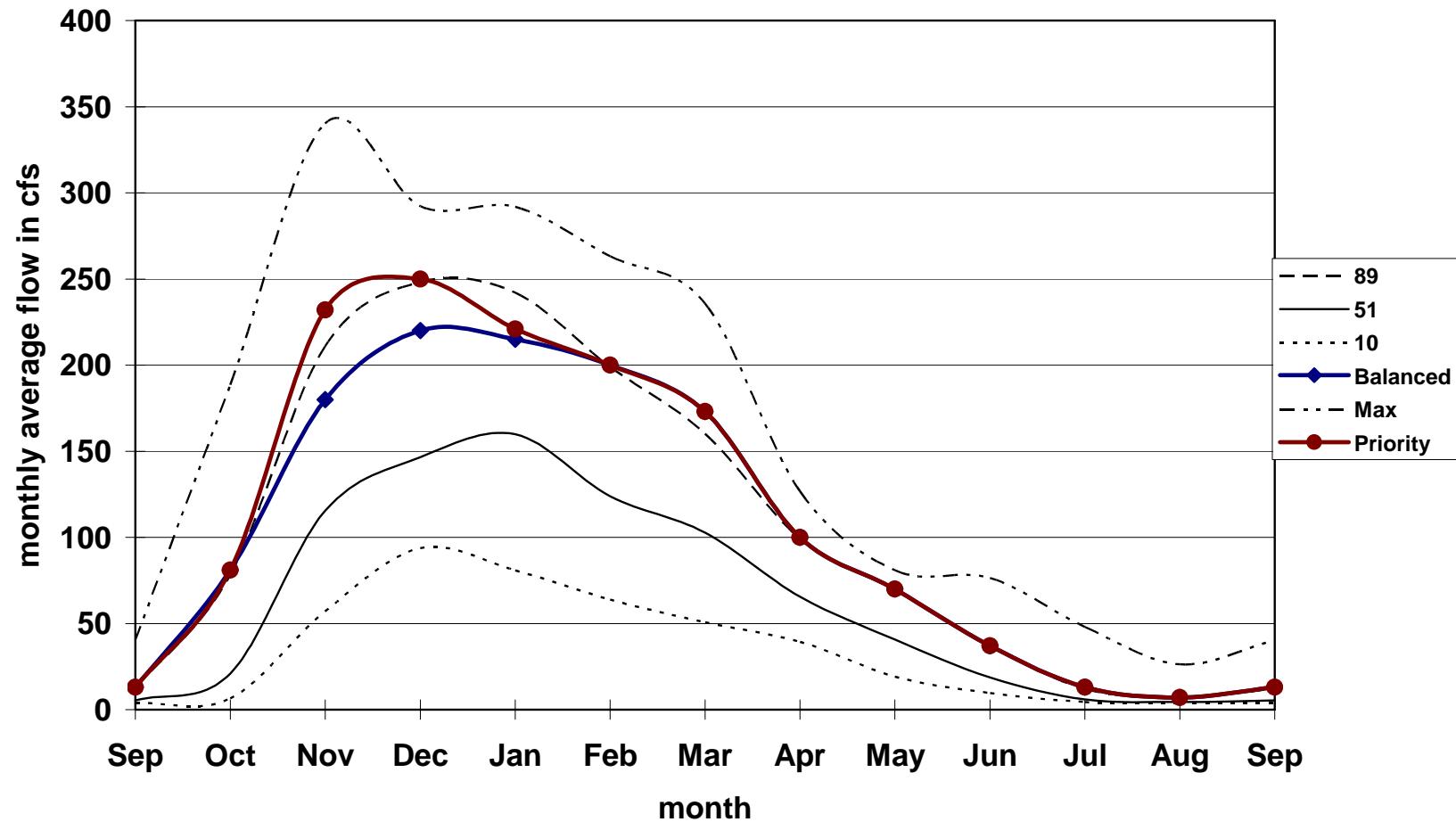
## Deep Creek Spawning WUA Transect 1- Riffle



## Deep Creek Rearing WUA Transects 2 - 4



**Deep Creek at Outlet 1962 - 99**  
**% time flow less than or equal to**



Summary of Suggested Flow Recommendations, Deep Creek									
Max WUA (cfs)	ChS	CoS	CmS	ShS	CoR	ChR	ShR		
Month/Days	Species and Life Stage			Suggested Flows		Hydrology (cfs)			
Oct 1-15	<b>ShR</b>	CoR		81	81	37	81.4	Max Bal = 250	
Oct 15-31	<b>CoS</b>			81	81	37	81.4	Max Bal = 250	
Nov 1-15	<b>CoS</b>	CmS		232	180	137	232.6	Max Bal = 180	
Nov 16-30	<b>CoS</b>	CmS		232	180	137	232.6	Max Bal = 180	
Dec 1-15	<b>CoS</b>	CmS	ShS	250	210	158	254.1	Max Bal = 210	
Dec 16-31	<b>CoS</b>		ShS	250	230	158	254.1	Max Bal = 230	
Jan 1-15	<b>CoS</b>		ShS	242	230	159	242.7	Max Bal = 230	
Jan 16-31			<b>ShS</b>	200	200	159	242.7	Max Bal = 200	
Feb			<b>ShS</b>	200	200	127	209.5	Max Bal = 200	
March	ShR	CoR	<b>ShS</b>	173	173	107	173.6	Max Bal = 210	
April	ShR	CoR	<b>ShS</b>	100	100	69	100.4	Max Bal = 210	
May	ShR	CoR	<b>ShS</b>	ShE	70	70	41	70.6	Max Bal = 210
June	ShR	CoR			37	37	22	37	Max Bal = 250
July	ShR	CoR			13	13	8	12.9	Max Bal = 250
Aug	ShR	CoR			7	7	6	7.5	Max Bal = 250
Sept	ShR	CoR			13	13	8	12.7	Max Bal = 250
CoR	Coho Rearing		ShR	Steelhead Rearing					
CoS	Coho Spawning		ShS	Steelhead Spawning					
ChR	Chinook Rearing		ShE	Steelhead Emergence					
ChS	Chinook Spawning								
CmS	Chum Spawning			<b>Bold = Priority Species</b>					

Deep Creek WUA, using the balanced approach of averaging WUA for species and life stages					
Flow	CoR/ ShR	CoS/ CmS	CoS/CmS/ ShS	CoS/ ShS	ShS/ShR/ CoR
1	1,757	2	1	0	1,171
2	1,863	57	38	0	1,242
3	1,983	146	97	0	1,322
4	2,092	253	169	0	1,395
5	2,170	370	247	0	1,447
10	2,222	1,137	758	51	1,482
15	2,241	2,100	1,400	167	1,494
20	2,237	3,017	2,012	295	1,492
25	2,239	3,945	2,692	547	1,555
30	2,262	4,947	3,518	950	1,728
35	2,282	5,990	4,408	1,440	1,936
40	2,350	7,111	5,393	2,043	2,219
45	2,407	8,325	6,475	2,746	2,530
50	2,465	9,570	7,586	3,500	2,850
55	2,523	10,819	8,718	4,328	3,186
60	2,580	12,045	9,840	5,201	3,531
65	2,643	13,258	10,983	6,155	3,905
70	2,690	14,461	12,140	7,164	4,292
75	2,738	15,613	13,279	8,210	4,696
80	2,800	16,753	14,416	9,261	5,115
90	2,864	18,888	16,602	11,322	5,920
100	2,908	20,862	18,562	13,188	6,592
110	2,931	22,803	20,427	14,900	7,178
120	2,950	24,617	22,154	16,479	7,709
130	2,958	26,298	23,723	17,931	8,163
140	2,961	27,748	25,110	19,240	8,586
150	2,965	28,973	26,287	20,416	8,948
160	3,030	29,571	27,144	21,515	9,450
170	3,068	30,166	27,741	22,282	9,675
180	3,118	<b>30,531</b>	28,112	22,890	9,837
190	3,278	30,245	28,217	23,435	10,240
200	3,335	30,378	28,329	23,756	10,301
210	3,387	30,421	<b>28,334</b>	23,994	<b>10,311</b>
220	3,442	30,413	28,255	24,155	10,274
230	3,494	30,358	28,100	<b>24,227</b>	10,191
240	3,545	30,163	27,825	24,226	10,079
250	<b>3,590</b>	29,870	27,479	24,190	9,959

**WEST TWIN RIVER**

**INSTREAM FLOW RECOMMENDATIONS**

Prepared for:

**WRIA 19 Planning Unit**

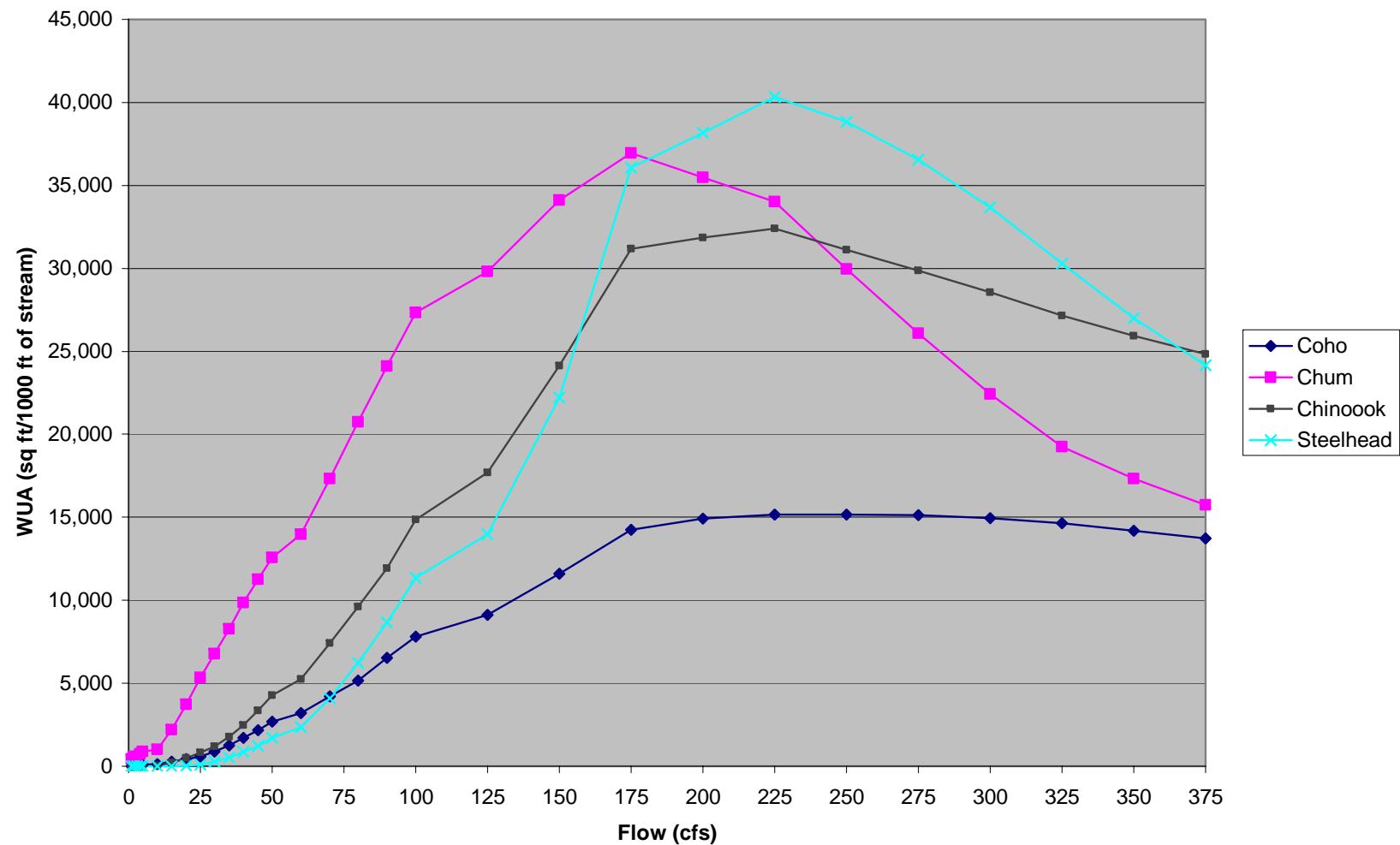
Prepared by:

**EES Consulting**

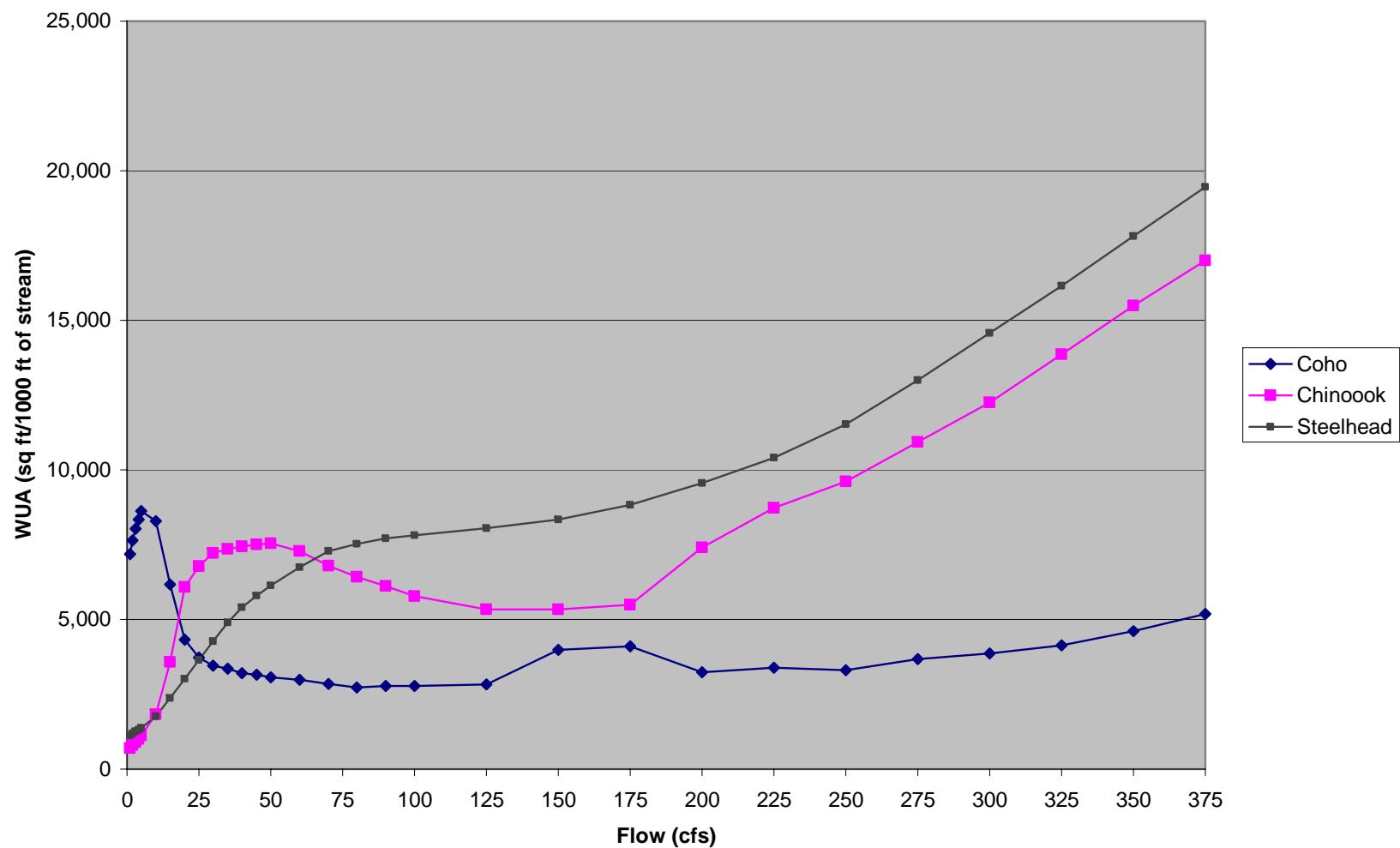
May 2005

W Twin River Spawning WUA Transect 1					W Twin River Rearing WUA Transects 2 - 4			
Flow	Coho	Chum	Chinook	Steelhead	Flow	Coho	Chinook	Steelhead
1	155	1,018	0	0	1	7,190	690	1,115
2	188	1,241	0	0	2	7,647	792	1,181
3	219	1,566	0	0	3	8,036	893	1,246
4	250	1,759	0	0	4	8,344	1,007	1,310
5	305	1,905	0	0	5	<b>8,623</b>	1,116	1,376
10	642	2,677	83	0	10	8,282	1,824	1,758
15	1,086	3,342	615	28	15	6,162	3,582	2,368
20	1,650	4,000	1,356	130	20	4,325	6,087	3,010
25	2,364	4,653	2,147	286	25	3,722	6,788	3,641
30	2,943	5,340	2,885	483	30	3,466	7,224	4,267
35	3,495	5,964	3,690	710	35	3,354	7,352	4,896
40	4,019	6,528	4,509	1,005	40	3,206	7,443	5,410
45	4,524	7,086	5,272	1,411	45	3,158	7,507	5,788
50	5,001	7,690	6,060	1,870	50	3,072	7,546	6,130
60	6,035	9,049	7,742	2,894	60	2,991	7,295	6,750
70	7,028	10,420	9,528	4,061	70	2,851	6,802	7,284
80	7,845	11,510	11,022	5,324	80	2,737	6,423	7,524
90	8,614	12,396	12,348	6,338	90	2,774	6,111	7,709
100	9,320	13,219	13,675	7,477	100	2,776	5,785	7,815
125	10,530	14,225	15,905	9,926	125	2,834	5,333	8,044
150	11,632	<b>14,766</b>	17,551	11,629	150	3,990	5,339	8,342
175	12,782	14,341	18,890	12,084	175	4,098	5,498	8,832
200	13,392	13,510	19,910	<b>12,113</b>	200	3,235	7,412	9,562
225	<b>13,621</b>	12,378	20,806	11,665	225	3,392	8,730	10,410
250	13,083	11,790	21,404	11,274	250	3,299	9,607	11,517
275	12,039	11,128	21,439	10,605	275	3,680	10,924	13,008
300	10,673	10,205	<b>21,467</b>	10,073	300	3,873	12,251	14,574
325	9,284	9,083	21,366	9,616	325	4,138	13,860	16,148
350	7,931	8,389	20,496	9,423	350	4,602	15,493	17,818
375	6,709	7,754	19,187	9,285	375	5,179	<b>17,003</b>	<b>19,465</b>
Max WUA Flow	13,621	14,766	21,467	12,113		8,623	17,003	19,465
	225	150	300	200		5	375	375

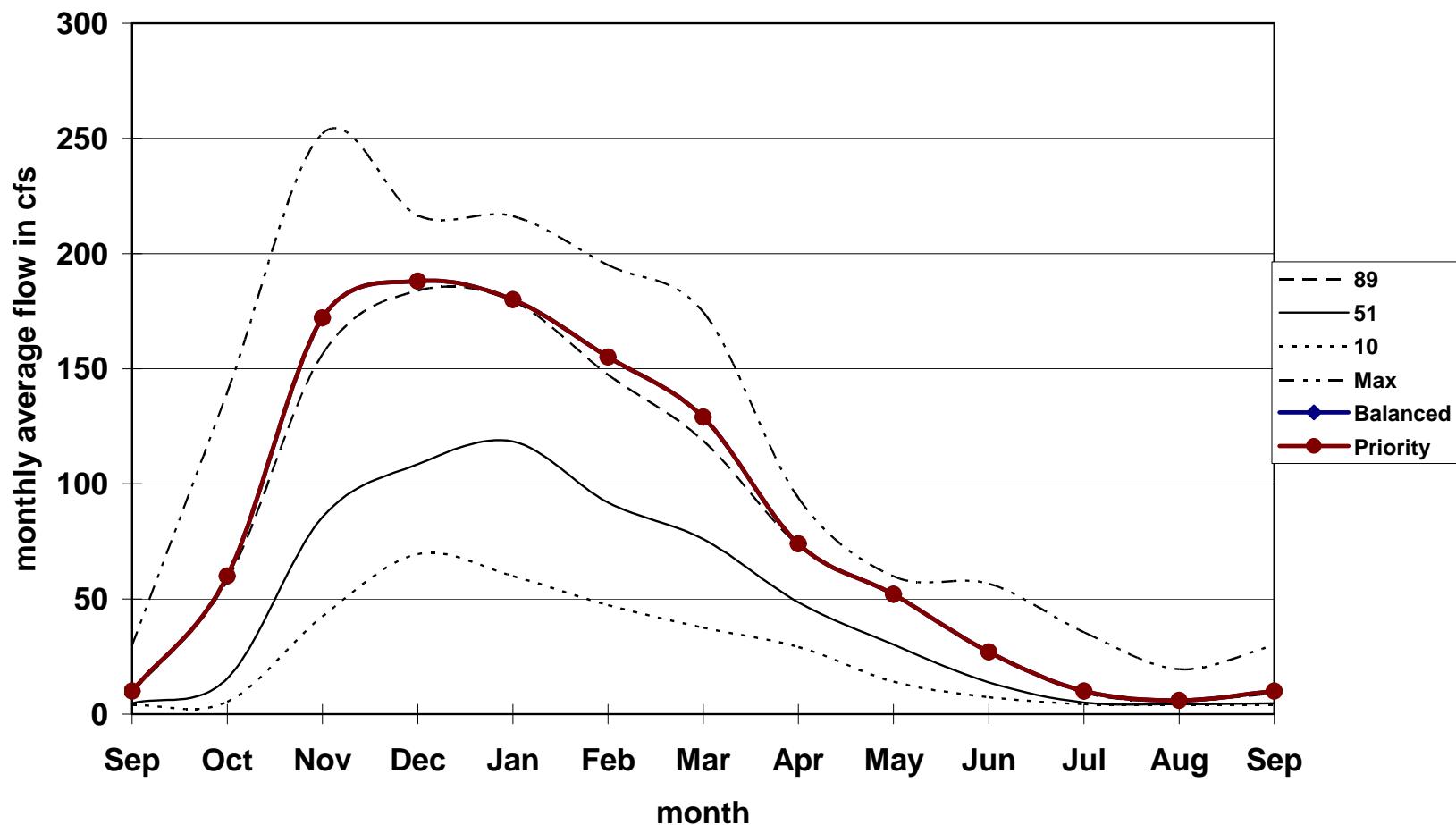
### West Twin River Spawning WUA - Transect 1



### West Twin River Rearing WUA - Transects 2 - 4



West Twin River at Outlet 1962 - 99  
% time flow less than or equal to



Summary of Flow Recommendations, West Twin River							
	ChS	CoS	CmS	ShS	CoR	ChR	ShR
Max WUA (cfs)	300	225	150	200	5	375	325
Month/Days	Species and Life Stage			Suggested Flows		Hydrology (cfs)	
Oct 1-15	<b>ShR</b>	CoR		Priority	Balanced	Mean	10 Ex
Oct 16-31	<b>CoS</b>						
Nov 1-15	<b>CoS</b>	CmS		172	172	101	172
Nov 16-30	<b>CoS</b>	CmS		172	172	101	172
Dec 1-15	<b>CoS</b>	CmS	ShS	175	175	117	188
Dec 16-31	<b>CoS</b>		ShS	188	188	117	188
Jan 1-15	<b>CoS</b>		ShS	180	180	118	180
Jan 16-31			<b>ShS</b>	118	180	118	180
Feb			<b>ShS</b>	155	155	94	155
March	ShR	CoR	<b>ShS</b>	129	129	79	129
April	ShR	CoR	<b>ShS</b>	74	74	51	74
May	ShR	CoR	<b>ShS</b>	52	52	30	52
June	ShR	CoR	ShE	27	27	17	27
July	ShR	CoR		10	10	7	10
Aug	ShR	CoR		6	6	5	6
Sept	ShR	CoR		10	10	7	10
CoR	Coho Rearing		ShR	Steelhead Rearing			
CoS	Coho Spawning		ShS	Steelhead Spawning			
ChR	Chinook Rearing		ShE	Steelhead Emergence			
ChS	Chinook Spawning			<b><i>Bold = Priority Species</i></b>			
CmS	Chum Spawning						

Analysis of Flow Scenarios by Species and Life Stage, W. Twin River					
Flow	SHR/CoR	CoS/CmS	CoS/CmS/ShS	CoS/ShS	ShS/ShR/CoR
1	4,152	586	391	77	2,768
2	4,414	715	476	94	2,943
3	4,641	892	595	110	3,094
4	4,827	1,005	670	125	3,218
5	5,000	1,105	737	152	3,333
10	5,020	1,660	1,107	321	3,347
15	4,265	2,214	1,485	557	2,853
20	3,668	2,825	1,927	890	2,488
25	3,682	3,508	2,434	1,325	2,550
30	3,867	4,142	2,922	1,713	2,739
35	4,125	4,730	3,390	2,103	2,987
40	4,308	5,274	3,851	2,512	3,207
45	4,473	5,805	4,340	2,968	3,452
50	4,601	6,346	4,854	3,436	3,691
60	4,871	7,542	5,993	4,465	4,212
70	5,067	8,724	7,170	5,545	4,732
80	5,130	9,678	8,226	6,584	5,195
90	5,241	10,505	9,116	7,476	5,607
100	5,295	11,270	10,005	8,399	6,022
125	5,439	12,377	11,560	10,228	6,935
150	6,166	13,199	12,675	11,630	7,987
175	6,465	<b>13,562</b>	<b>13,069</b>	12,433	8,338
200	6,399	13,451	13,005	<b>12,752</b>	8,303
225	6,901	12,999	12,555	12,643	8,489
250	7,408	12,436	12,049	12,179	8,697
275	8,344	11,584	11,258	11,322	9,098
300	9,223	10,439	10,317	10,373	9,507
325	10,143	9,184	9,328	9,450	9,967
350	11,210	8,160	8,581	8,677	10,614
375	<b>12,322</b>	7,232	7,916	7,997	<b>11,310</b>
	12,322	13,562	13,069	12,752	11,310
	375	175	175	200	375

# **EAST TWIN RIVER**

## **INSTREAM FLOW RECOMMENDATIONS**

Prepared for:

**WRIA 19 Planning Unit**

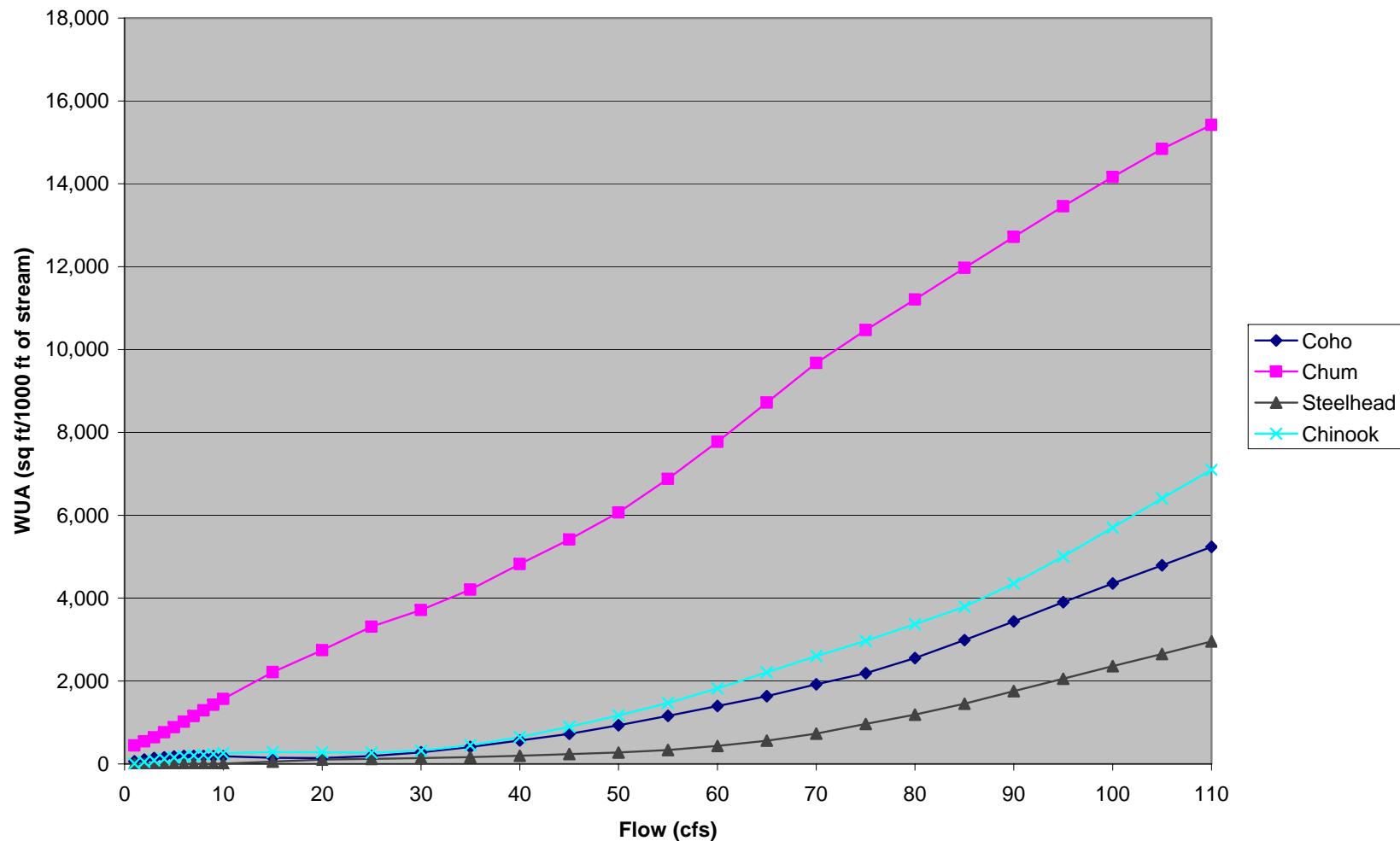
Prepared by:

**EES Consulting**

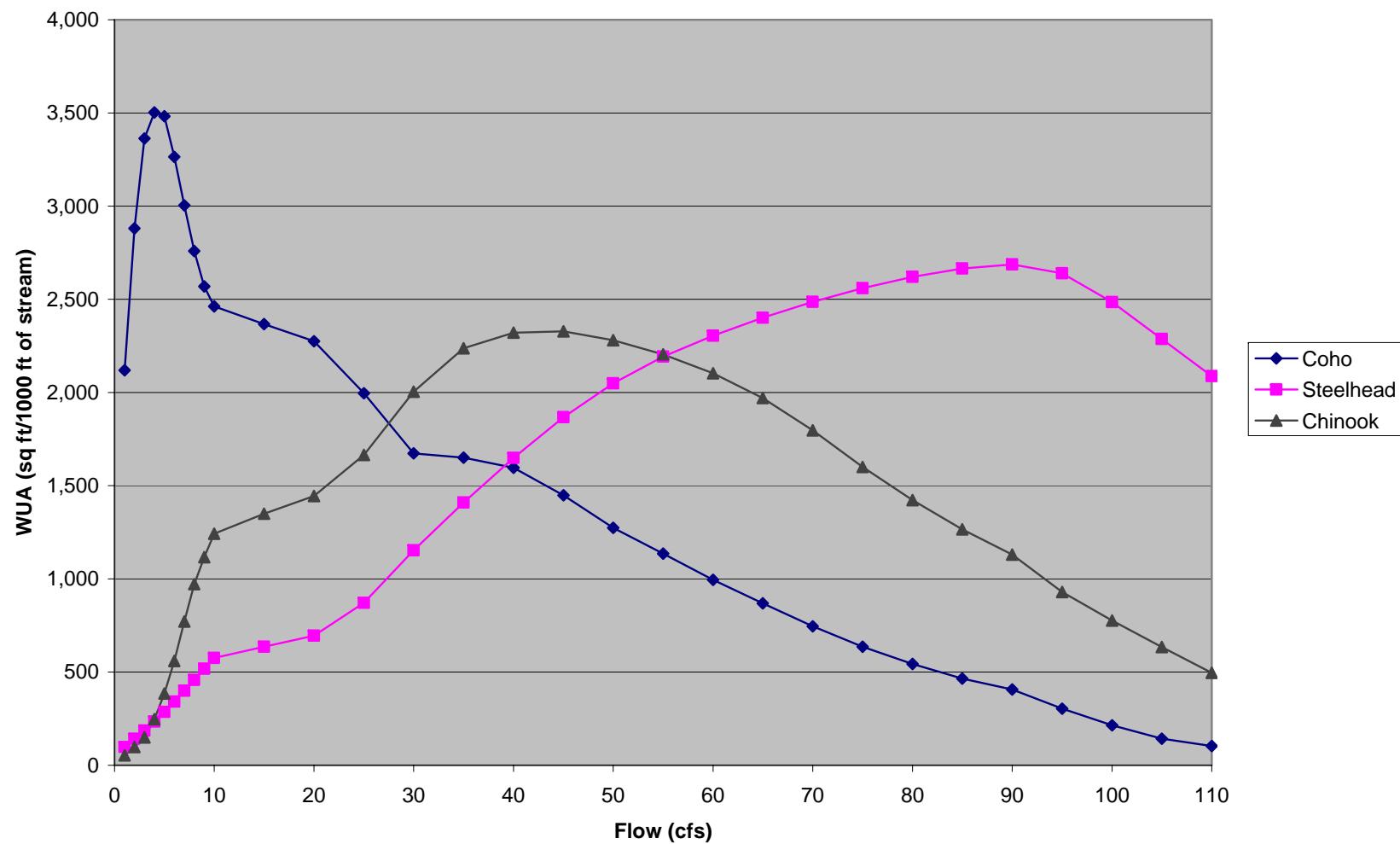
May 2005

East Twin River Spawning WUA - Transect 1 (riffle)					East Twin River Rearing WUA - Transects 2 - 4, Rearing			
Flow	Coho	Chum	Steelhead	Chinook	Flow	Coho	Steelhead	Chinook
1	64	442	0	6	1	2,119	97	53
2	106	540	0	47	2	2,880	142	98
3	141	642	0	87	3	3,363	186	149
4	159	760	0	120	4	3,502	234	246
5	175	886	0	155	5	3,483	286	385
6	188	1,017	0	183	6	3,264	341	560
7	190	1,152	0	204	7	3,004	400	772
8	190	1,291	0	222	8	2,759	459	972
9	185	1,428	1	237	9	2,569	518	1,116
10	180	1,570	8	255	10	2,462	576	1,242
15	145	2,213	57	288	15	2,367	635	1,349
20	141	2,743	103	281	20	2,275	695	1,444
25	189	3,311	121	267	25	1,996	871	1,665
30	278	3,713	138	320	30	1,674	1,153	2,004
35	411	4,205	166	451	35	1,650	1,409	2,237
40	567	4,823	198	647	40	1,596	1,649	2,321
45	727	5,416	237	894	45	1,448	1,867	2,328
50	930	6,065	276	1,172	50	1,274	2,048	2,281
55	1,158	6,875	334	1,467	55	1,136	2,193	2,204
60	1,394	7,772	433	1,821	60	995	2,305	2,102
65	1,637	8,720	564	2,209	65	868	2,401	1,971
70	1,919	9,678	733	2,603	70	746	2,486	1,797
75	2,191	10,471	962	2,967	75	636	2,560	1,601
80	2,552	11,208	1,192	3,373	80	544	2,620	1,423
85	2,985	11,967	1,451	3,792	85	465	2,665	1,266
90	3,442	12,717	1,754	4,352	90	406	2,687	1,130
95	3,903	13,459	2,056	5,009	95	304	2,640	929
100	4,351	14,165	2,358	5,704	100	214	2,485	776
105	4,795	14,839	2,653	6,408	105	142	2,287	635
110	5,236	15,423	2,956	7,101	110	103	2,088	497
Max	5,236	15,423	2,956	7,101		3,502	2,687	2,328
	110	110	110	110		4	90	45

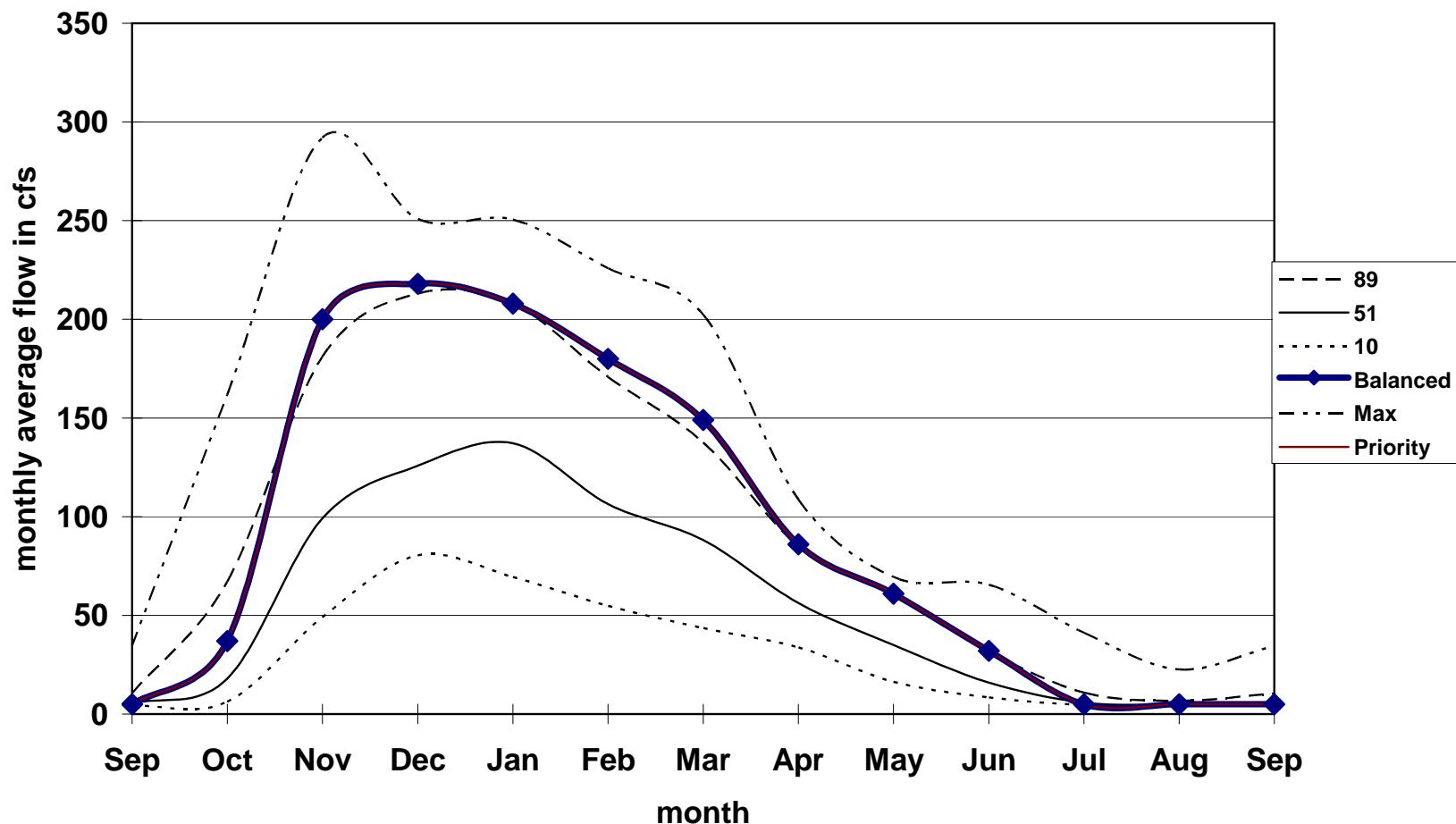
### E Twin R Spawning WUA - Transect 1 (riffle)



### E Twin R Rearing WUA - Transects 2 - 4



**East Twin River at Outlet 1962 - 99**  
**% time flow less than or equal to**



Summary of Suggested Flow Recommendations, East Twin River

	ChS	CoS	CmS	ShS	CoR	ChR	ShR		
Max WUA (cfs)	350+	350+	275	350+	4	45	90		
Month/Days					Suggested Flows		Hydrology (cfs)		Comments
	Species	Life Stage	Priority	Balanced	Mean	10 Exc			
Oct 1-15	ShR	<b>CoR</b>		70	70	32	70		
Oct 15-31	<b>CoS</b>			70	70	32	70	WUA exceeds flows	
Nov 1-15	<b>CoS</b>	CmS		200	200	117	200	WUA exceeds flows	
Nov 16-30	<b>CoS</b>	CmS		200	200	117	200	WUA exceeds flows	
Dec 1-15	<b>CoS</b>	CmS	<b>ShS</b>	218	218	135	218	WUA exceeds flows	
Dec 16-31	<b>CoS</b>	<b>ShS</b>		218	218	135	218	WUA exceeds flows	
Jan 1-15	<b>CoS</b>	<b>ShS</b>		208	208	137	208	WUA exceeds flows	
Jan 16-31	<b>ShS</b>			208	208	137	208	WUA exceeds flows	
Feb	<b>ShS</b>			180	180	109	180	WUA exceeds flows	
March	<b>ShS</b>	ShR	CoR	149	149	92	149	WUA exceeds flows	
April	<b>ShS</b>	ShR	CoR	86	86	59	86	WUA exceeds flows	
May	<b>ShS</b>	ShR	CoR	ShE	61	61	35	61	WUA exceeds flows
June	<b>ShR</b>	CoR	ShE		32	32	19	32	WUA exceeds flows
July	<b>ShR</b>	CoR			5	5	8	11	WUA exceeds flows
Aug	<b>ShR</b>	CoR			5	5	6	7	WUA exceeds flows
Sept	<b>ShR</b>	CoR			5	5	7	11	WUA exceeds flows
CoR	Coho Rearing		ShR	Steelhead Rearing Steelhead					
CoS	Coho Spawning		ShS	Spawning					
ChR	Chinook Rearing		ShE	Steelhead Emergence					
ChS	Chinook Spawning								
CmS	Chum Spawning			<b><i>Bold = Priority Species</i></b>					

East Twin River WUA, using the balanced approach of averaging WUA for species and life stages			
Flow	ShR/CoR	CoS/CmS	ShR/CoR/ ShS
1	1,108	253	739
2	1,511	323	1,007
3	1,775	391	1,183
4	1,868	460	1,245
5	1,884	531	1,256
6	1,803	603	1,202
7	1,702	671	1,135
8	1,609	740	1,073
9	1,543	806	1,029
10	1,519	875	1,016
15	1,501	1,179	1,020
20	1,485	1,442	1,024
25	1,434	1,750	996
30	1,414	1,995	988
35	1,529	2,308	1,075
40	1,623	2,695	1,148
45	1,658	3,071	1,184
50	1,661	3,497	1,199
55	1,664	4,016	1,221
60	1,650	4,583	1,244
65	1,634	5,178	1,278
70	1,616	5,799	1,321
75	1,598	6,331	1,386
80	1,582	6,880	1,452
85	1,565	7,476	1,527
90	1,547	8,079	1,616
95	1,472	8,681	1,667
100	1,349	9,258	1,685
105	1,215	9,817	1,694
110	1,096	10,330	1,716

# **LYRE RIVER STUDY SITE 1**

## **INSTREAM FLOW RECOMMENDATIONS**

Prepared for:

**WRIA 19 Planning Unit**

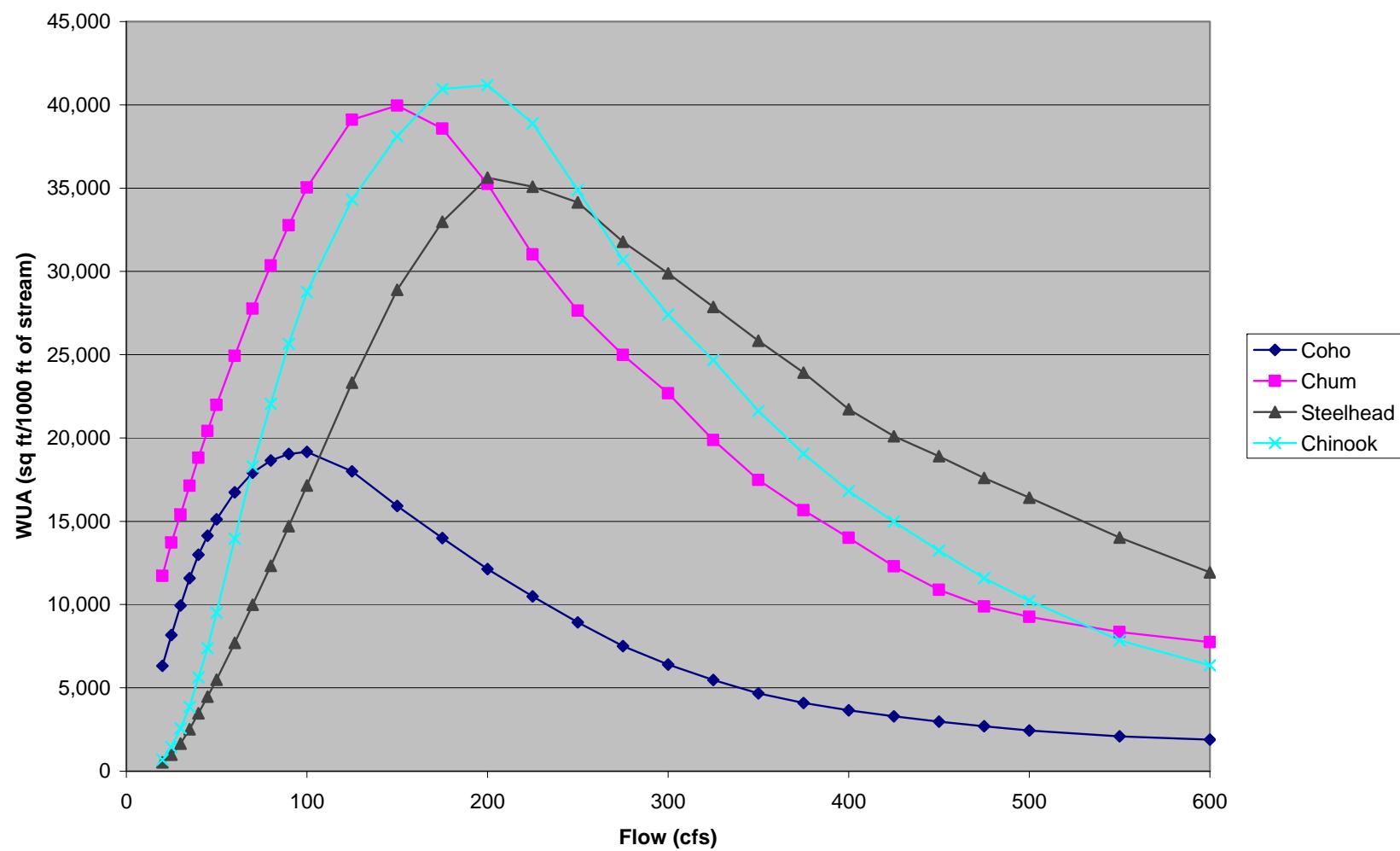
Prepared by:

**EES Consulting**

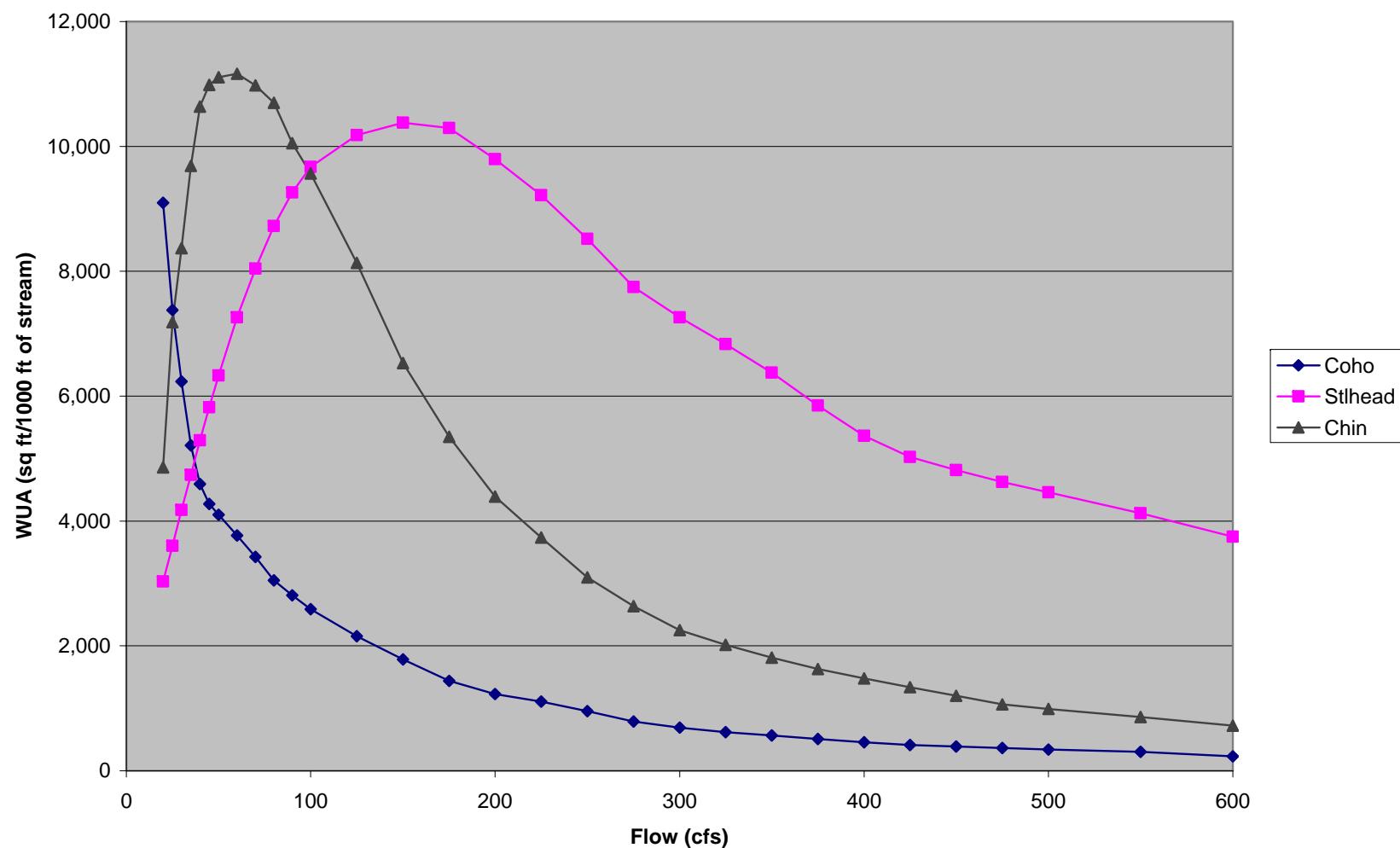
May 2005

Lyre River Study Site 1 Weighted Usable Area								
Spawning WUA Transect 1 (riffle)					Rearing WUA Transects 2 - 4			
Flow	CoS	CmS	ShS	ChS	Flow	CoR	ShR	ChR
20	6,320	11,718	527	684	20	<b>9,098</b>	3,034	4,861
25	8,180	13,728	979	1,440	25	7,377	3,604	7,186
30	9,948	15,404	1,658	2,577	30	6,235	4,178	8,370
35	11,581	17,140	2,522	3,851	35	5,213	4,739	9,686
40	12,987	18,817	3,477	5,631	40	4,594	5,292	10,638
45	14,137	20,420	4,472	7,383	45	4,275	5,824	10,985
50	15,110	21,987	5,486	9,510	50	4,100	6,333	11,106
60	16,740	24,919	7,696	13,943	60	3,769	7,260	<b>11,162</b>
70	17,928	27,756	9,993	18,288	70	3,425	8,044	10,978
80	18,643	30,352	12,327	22,044	80	3,050	8,724	10,697
90	19,046	32,767	14,712	25,647	90	2,809	9,264	10,051
100	<b>19,161</b>	35,041	17,152	28,763	100	2,589	9,670	9,568
125	17,992	39,107	23,318	34,304	125	2,153	10,181	8,135
150	15,923	<b>39,958</b>	28,901	38,121	150	1,785	<b>10,378</b>	6,530
175	13,991	38,575	32,983	40,951	175	1,438	10,294	5,350
200	12,136	35,252	<b>35,623</b>	<b>41,179</b>	200	1,229	9,797	4,389
225	10,496	31,017	35,088	38,886	225	1,109	9,217	3,735
250	8,923	27,647	34,137	34,887	250	952	8,519	3,096
275	7,498	24,980	31,778	30,705	275	790	7,746	2,634
300	6,404	22,688	29,878	27,406	300	692	7,260	2,251
325	5,473	19,883	27,871	24,674	325	618	6,834	2,020
350	4,667	17,484	25,841	21,626	350	567	6,376	1,810
375	4,092	15,668	23,926	19,063	375	510	5,849	1,629
400	3,660	14,003	21,733	16,816	400	456	5,366	1,480
425	3,295	12,299	20,108	14,985	425	412	5,024	1,339
450	2,966	10,890	18,914	13,243	450	386	4,814	1,201
475	2,699	9,885	17,605	11,580	475	362	4,625	1,064
500	2,437	9,271	16,424	10,230	500	339	4,460	991
550	2,096	8,361	14,022	7,858	550	302	4,125	861
600	1,900	7,744	11,931	6,360	600	232	3,747	724
Max	19,161	39,958	35,623	41,179	Max	9,098	10,378	11,162
	100	150	200	200		20	150	60

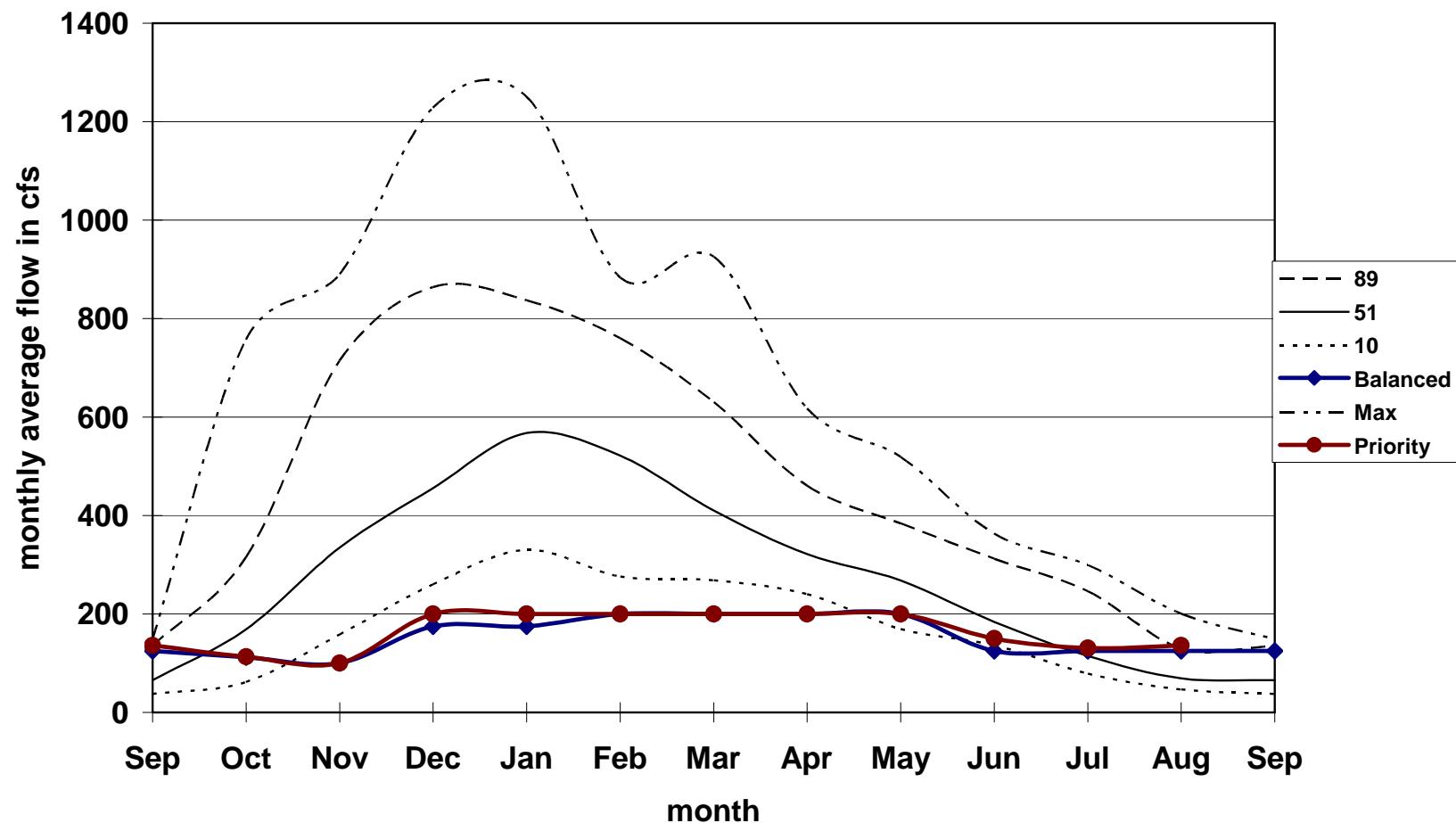
### Hoko River Study Site 1 Spawning WUA - Riffle



### Lyre River Study Site 1 Rearing WUA - Transects 2 - 4



**Lyre River at Outlet 1962 - 99**  
**% time flow less than or equal to**



Summary of Suggested Flow Recommendations, Lyre River Study Site 1											
Max WUA (cfs)	ChS	CoS	CmS	ShS	CoR	ChR	ShR				
	200	100	150	200	20	60	150				
Month/Days	Species and Life Stage		Suggested Flows		Hydrology						
	Priority	Balanced	Mean	10% Exc	Comments						
Oct 1-15	<b>ShR</b>	CoR	125	125	188	327 Bal WUA = 125					
Oct 15-31		<b>CoS</b>	100	100	188	327 Bal WUA = 100					
Nov 1-15		<b>CoS</b>	100	100	385	716 Bal WUA = 100					
Nov 16-30		<b>CoS</b>	100	100	385	716 Bal WUA = 100					
Dec 1-15	CoS	CmS	<b>ShS</b>	200	175	521	873 Bal WUA = 175				
Dec 16-31	CoS	<b>ShS</b>	CmS	200	175	521	873 Bal WUA = 175				
Jan 1-15	CoS	<b>ShS</b>	CmS	200	175	608	862 Bal WUA = 175				
Jan 16-31	<b>ShS</b>	CmS		200	175	608	862 Bal WUA = 175				
Feb	<b>ShS</b>			200	200	522	773 Bal WUA = 200				
March	<b>ShS</b>	ShR	CoR	200	200	446	642 Bal WUA = 200				
April	<b>ShS</b>	ShR	CoR	200	200	339	475 Bal WUA = 200				
May	<b>ShS</b>	ShR	CoR	<b>ShE</b>	200	276	390 Bal WUA = 200				
June		<b>ShR</b>	CoR	<b>ShE</b>	150	125	313 Bal WUA = 125				
July		<b>ShR</b>	CoR		150	125	262 Bal WUA = 125				
Aug		<b>ShR</b>	CoR		131	125	131 Bal WUA = 125				
Sept		<b>ShR</b>	CoR		136	125	136 Bal WUA = 125				
<b>Flow Allocation: 10% Median Flow Nov - May = 40.8 cfs</b>											
CoR	Coho Rearing		ShR	Steelhead Rearing							
CoS	Coho Spawning		ShS	Steelhead Spawning							
ChR	Chinook Rearing		ShE	Steelhead Emergence							
ChS	Chinook Spawning		<b>Bold = Priority Species</b>								
CmS	Chum Spawning										

**Lyre River SS1 WUA, using the balanced approach of averaging WUA for species and life stages.**

Flow	ShR/CoR	CoS/CmS/ ShS	ShS/CmS	ShS/ShR/ CoR
20	6,066	6,188	6,122	4,220
25	5,491	7,629	7,354	3,987
30	5,206	9,003	8,531	4,024
35	4,976	10,414	9,831	4,158
40	4,943	11,760	11,147	4,455
45	5,049	13,010	12,446	4,857
50	5,216	14,194	13,736	5,306
60	5,514	16,451	16,307	6,241
70	5,734	18,559	18,874	7,154
80	5,887	20,441	21,340	8,034
90	6,037	22,175	23,739	8,928
100	6,130	23,785	26,097	9,804
125	6,167	26,806	31,212	11,884
150	6,082	28,261	34,430	13,688
175	5,866	28,516	35,779	14,905
200	5,513	27,671	35,438	15,550
225	5,163	25,533	33,052	15,138
250	4,736	23,569	30,892	14,536
275	4,268	21,419	28,379	13,438
300	3,976	19,657	26,283	12,610
325	3,726	17,742	23,877	11,774
350	3,472	15,998	21,663	10,928
375	3,180	14,562	19,797	10,095
400	2,911	13,132	17,868	9,185
425	2,718	11,901	16,204	8,515
450	2,600	10,923	14,902	8,038
475	2,494	10,063	13,745	7,531
500	2,399	9,377	12,847	7,074
550	2,214	8,159	11,191	6,150
600	1,989	7,192	9,837	5,303
	6,167	28,516	35,779	15,550
	125	175	175	200

**LYRE RIVER STUDY SITE 2  
CLALLAM PUD SITE  
INSTREAM FLOW RECOMMENDATIONS**

Prepared for:

**WRIA 19 Planning Unit**

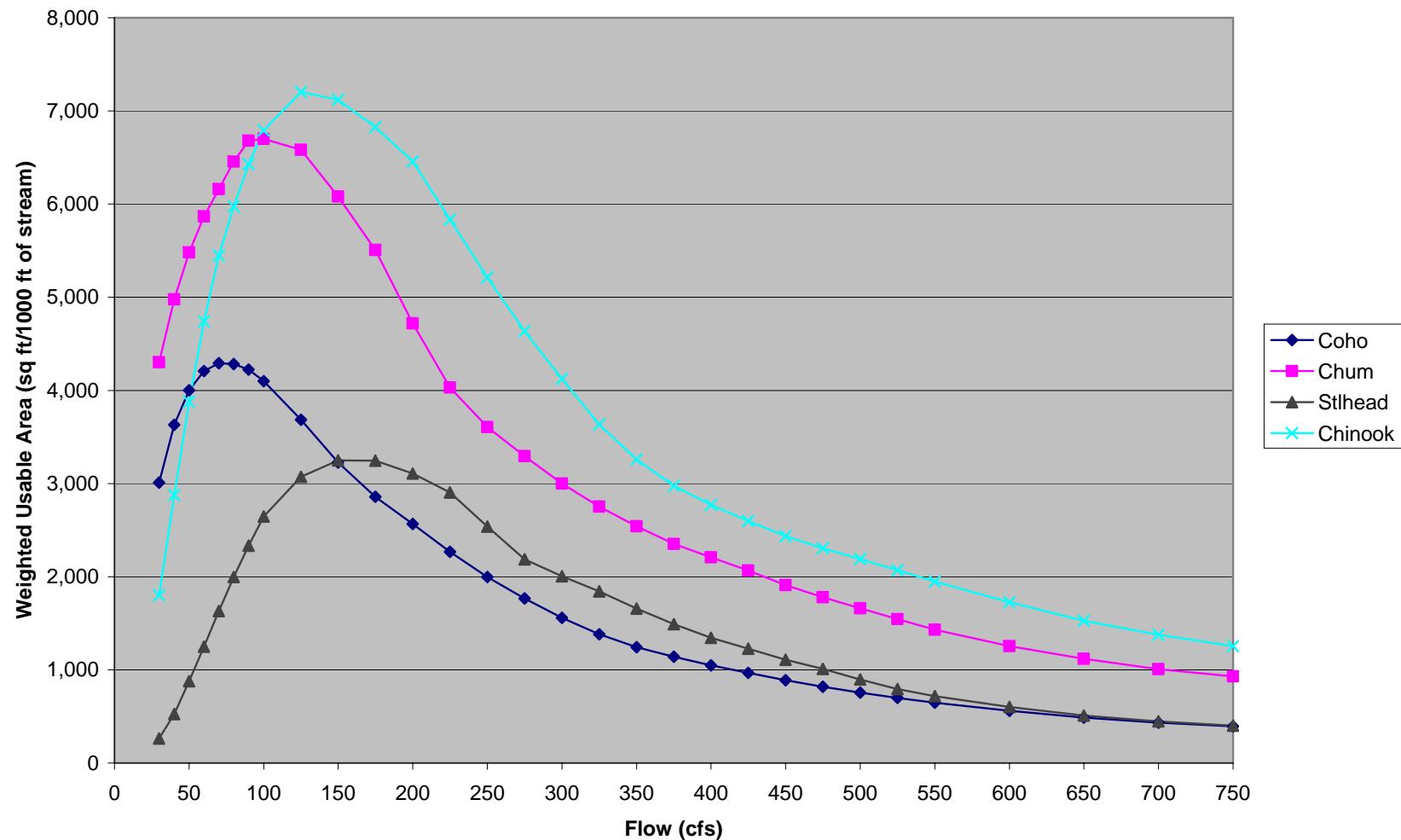
Prepared by:

**EES Consulting**

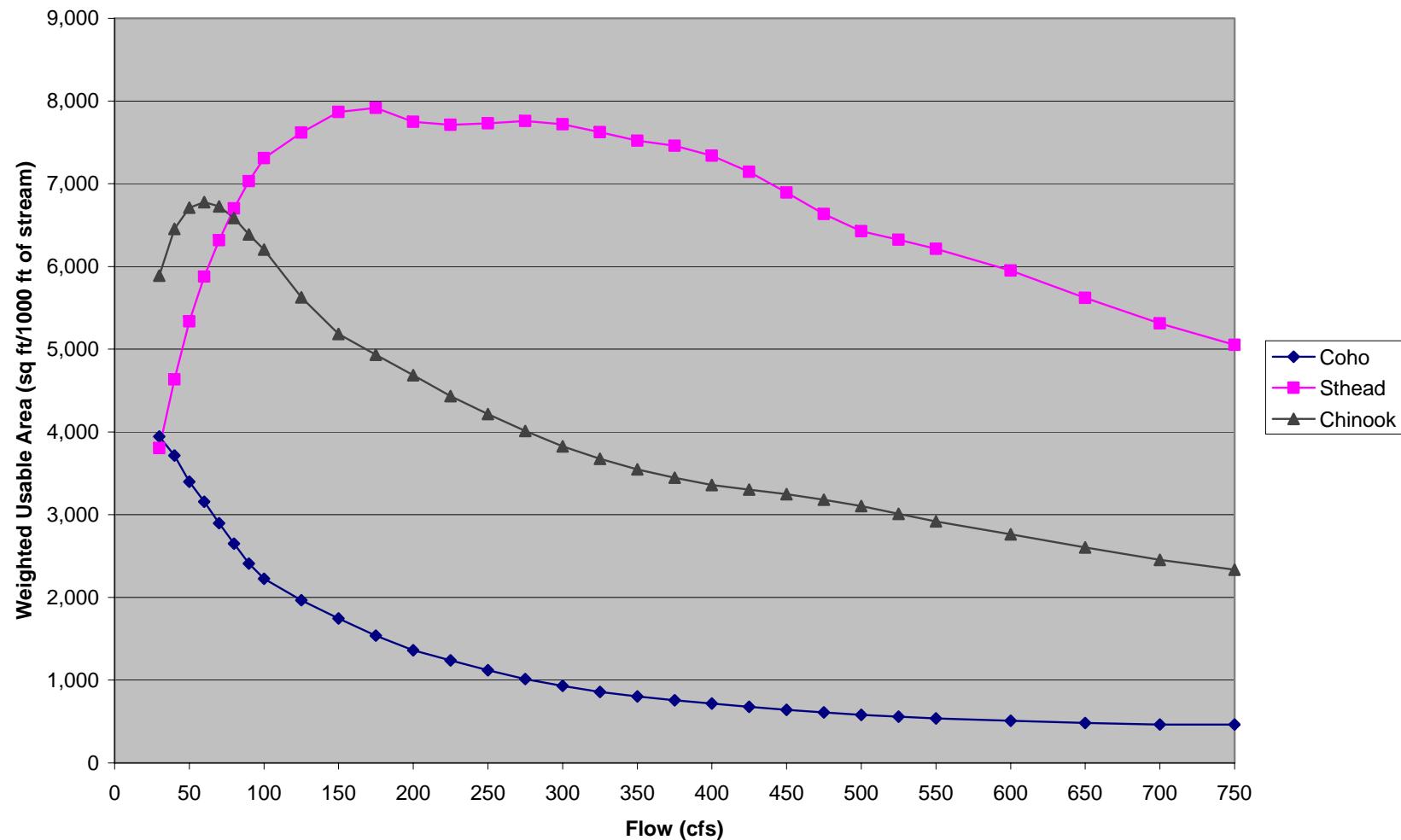
May 2005

Lyre Canyon Study Site 2 WUA - Clallam County PUD										
Spawning WUA						Rearing WUA				
Flow	Coho	Chum	Stlhead	Chinook		Flow	Coho	Sthead	Chinook	
30	3,011	4,302	264	1,800			30	<b>3,946</b>	3,805	5,889
40	3,631	4,976	527	2,877			40	3,716	4,633	6,455
50	4,003	5,480	876	3,876			50	3,398	5,337	6,710
60	4,207	5,869	1,248	4,742			60	3,157	5,876	<b>6,779</b>
70	<b>4,292</b>	6,160	1,631	5,448			70	2,898	6,317	6,727
80	4,283	6,457	1,996	5,972			80	2,649	6,703	6,584
90	4,222	6,681	2,331	6,428			90	2,408	7,032	6,386
100	4,099	<b>6,699</b>	2,646	6,793			100	2,224	7,309	6,203
125	3,683	6,582	3,072	<b>7,204</b>			125	1,965	7,617	5,626
150	3,227	6,082	<b>3,249</b>	7,120			150	1,748	7,869	5,184
175	2,858	5,508	3,245	6,826			175	1,540	<b>7,918</b>	4,933
200	2,565	4,719	3,107	6,459			200	1,361	7,747	4,686
225	2,267	4,033	2,904	5,836			225	1,239	7,713	4,434
250	1,997	3,607	2,538	5,213			250	1,121	7,731	4,217
275	1,767	3,293	2,186	4,634			275	1,012	7,759	4,011
300	1,557	2,998	2,004	4,122			300	931	7,718	3,824
325	1,381	2,754	1,842	3,635			325	859	7,624	3,675
350	1,244	2,542	1,658	3,260			350	802	7,518	3,548
375	1,140	2,351	1,490	2,975			375	756	7,460	3,445
400	1,049	2,208	1,345	2,771			400	716	7,339	3,358
425	967	2,068	1,227	2,597			425	678	7,143	3,303
450	890	1,909	1,107	2,437			450	641	6,892	3,247
475	817	1,779	1,010	2,307			475	610	6,633	3,180
500	756	1,660	896	2,190			500	580	6,427	3,105
525	699	1,544	792	2,070			525	558	6,321	3,011
550	648	1,429	718	1,947			550	539	6,214	2,918
600	561	1,254	601	1,725			600	511	5,950	2,762
650	489	1,119	508	1,529			650	484	5,621	2,604
700	435	1,009	447	1,377			700	466	5,311	2,455
750	392	929	401	1,255			750	463	5,054	2,337
Max WUA Flow	4,292	6,699	3,249	<b>7,204</b>			3,946	7,918	6,779	
	70	100	150	125			30	175	60	

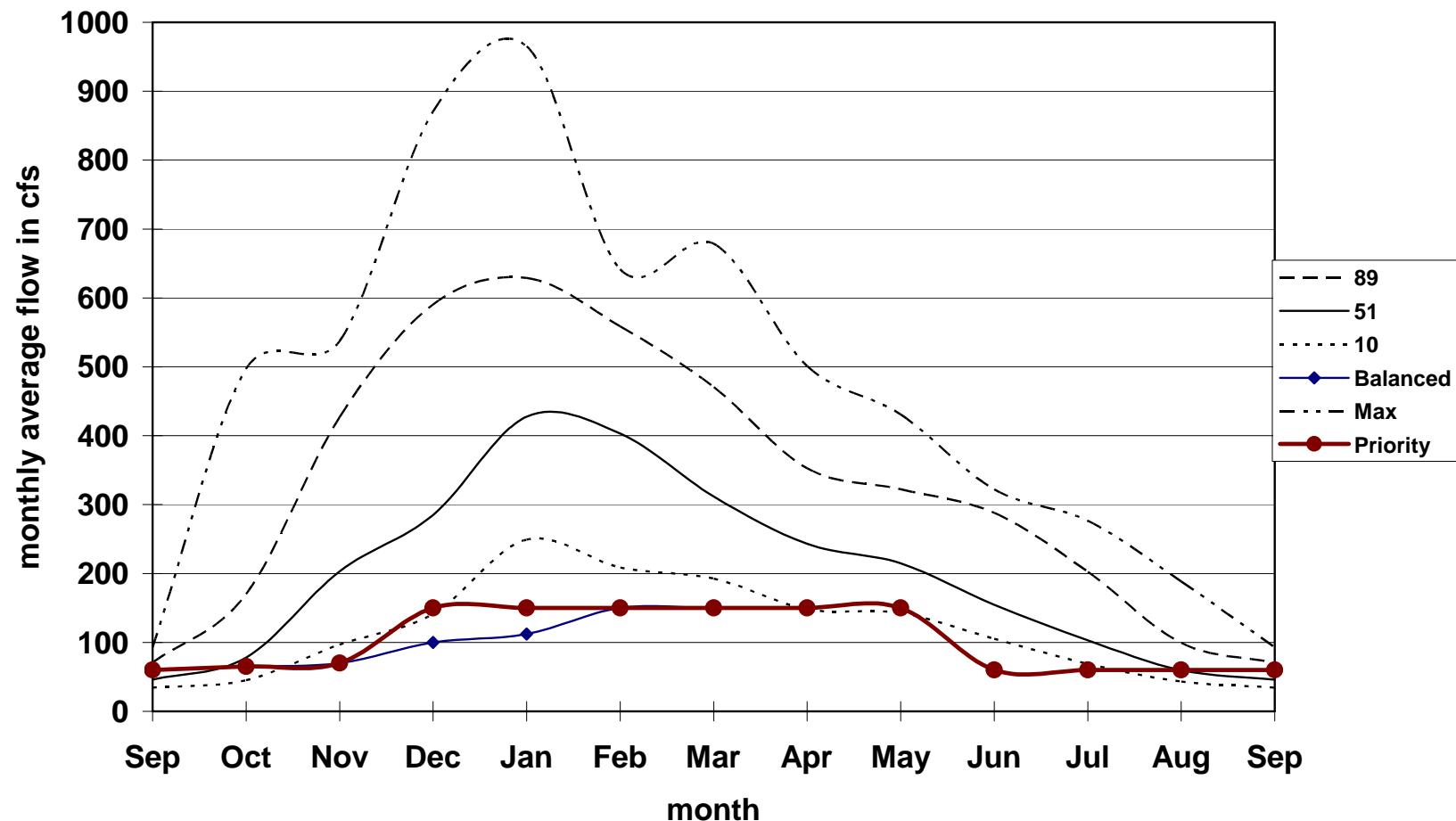
**Lyre River Study Site 2 Canyon Site WUA  
Spawning**



**Lyre River Study Site 2 Canyon Site WUA  
Rearing**



**Lyre River at Piedmont (Gage #12044000) 1962 - 99**  
**% time flow less than or equal to**



Summary of Maximum WUA, Upper Lyre River Site (Clallam PUD)									
Max WUA (cfs)	ChS	CoS	ChS	ShS	CoR	Chr	ShR		
	125	70	100	150	30	60	175		
Month/Days	Species and Life Stage			Suggested Flows		Hydrology			
	Priority	Balanced	Mean	10% Ex	Comments				
Oct 1-15	<b>ShR</b>	CoR		60	60	102	193	Max Bal Norm	
Oct 15-31		<b>CoS</b>		70	70	102	193	Max WUA	
Nov 1-15		<b>CoS</b>		70	70	238	441	Max WUA	
Nov 16-30		<b>CoS</b>		70	70	238	441	Max WUA	
Dec 1-15	CoS	CmS	<b>ShS</b>	150	100	341	608	Max Bal WUA	
Dec 16-31	CoS	CmS	<b>ShS</b>	150	100	341	608	Max Bal WUA	
Jan 1-15	CoS	CmS	<b>ShS</b>	150	100	449	645	Max Bal WUA	
Jan 16-31		CmS	<b>ShS</b>	150	125	449	645	Max Bal WUA	
Feb			<b>ShS</b>	150	150	394	585	Max	
March	CoR	ShR	<b>ShS</b>	150	150	338	494	Max Bal WUA	
April	CoR	ShR	<b>ShS</b>	150	150	249	359	Max Bal WUA	
May	CoR	ShR	<b>ShS</b>	ShE	150	150	224	325	Max Bal WUA
June	CoR	ShR		ShE	60	60	175	290	Max Bal Norm
July	CoR	ShR			60	60	122	210	Max Bal Norm
Aug	CoR	ShR			60	60	67	105	Max Bal Norm
Sept	CoR	ShR			60	60	50	71	Max Bal Norm
<i>Flow Allocation: 10% of Median Flow, Nov - May = 30.8 cfs</i>									
CoR	Coho Rearing			ShR	Steelhead Rearing				
CoS	Coho Spawning			ShS	Steelhead Spawning				
ChR	Chinook Rearing			ShE	Steelhead Emergence				
ChS	Chinook Spawning				<b>Bold = Priority Species</b>				
CmS	Chum Spawning								

Lyre River SS2 WUA using the balanced approach of averaging WUA for species and life stages				
Flow	ShR/CoR	CoS/CmS/ ShS	CmS/ShS	ShS/ShR/ CoR
30	3,875	2,525	2,283	2,671
40	4,174	3,044	2,751	2,959
50	4,367	3,453	3,178	3,204
60	4,516	3,775	3,558	3,427
70	4,607	4,028	3,895	3,615
80	4,676	4,245	4,226	3,783
90	4,720	4,412	4,506	3,924
100	4,767	4,481	4,673	4,060
125	4,791	4,446	4,827	4,218
150	4,808	4,186	4,665	4,288
175	4,729	3,871	4,377	4,234
200	4,554	3,464	3,913	4,072
225	4,476	3,068	3,468	3,952
250	4,426	2,714	3,072	3,797
275	4,385	2,415	2,739	3,652
300	4,325	2,186	2,501	3,551
325	4,242	1,992	2,298	3,442
350	4,160	1,815	2,100	3,326
375	4,108	1,660	1,921	3,235
400	4,027	1,534	1,776	3,133
425	3,910	1,421	1,647	3,016
450	3,767	1,302	1,508	2,880
475	3,621	1,202	1,394	2,751
500	3,504	1,104	1,278	2,634
525	3,440	1,012	1,168	2,557
550	3,376	932	1,073	2,490
600	3,230	805	927	2,354
650	3,052	705	814	2,204
700	2,888	630	728	2,074
750	2,758	574	665	1,972
Max Flow (cfs)	4,808 150	4,481 100	4,827 125	4,288 150

# **SALT CREEK INSTREAM FLOW RECOMMENDATIONS**

Prepared for:

**WRIA 19 Planning Unit**

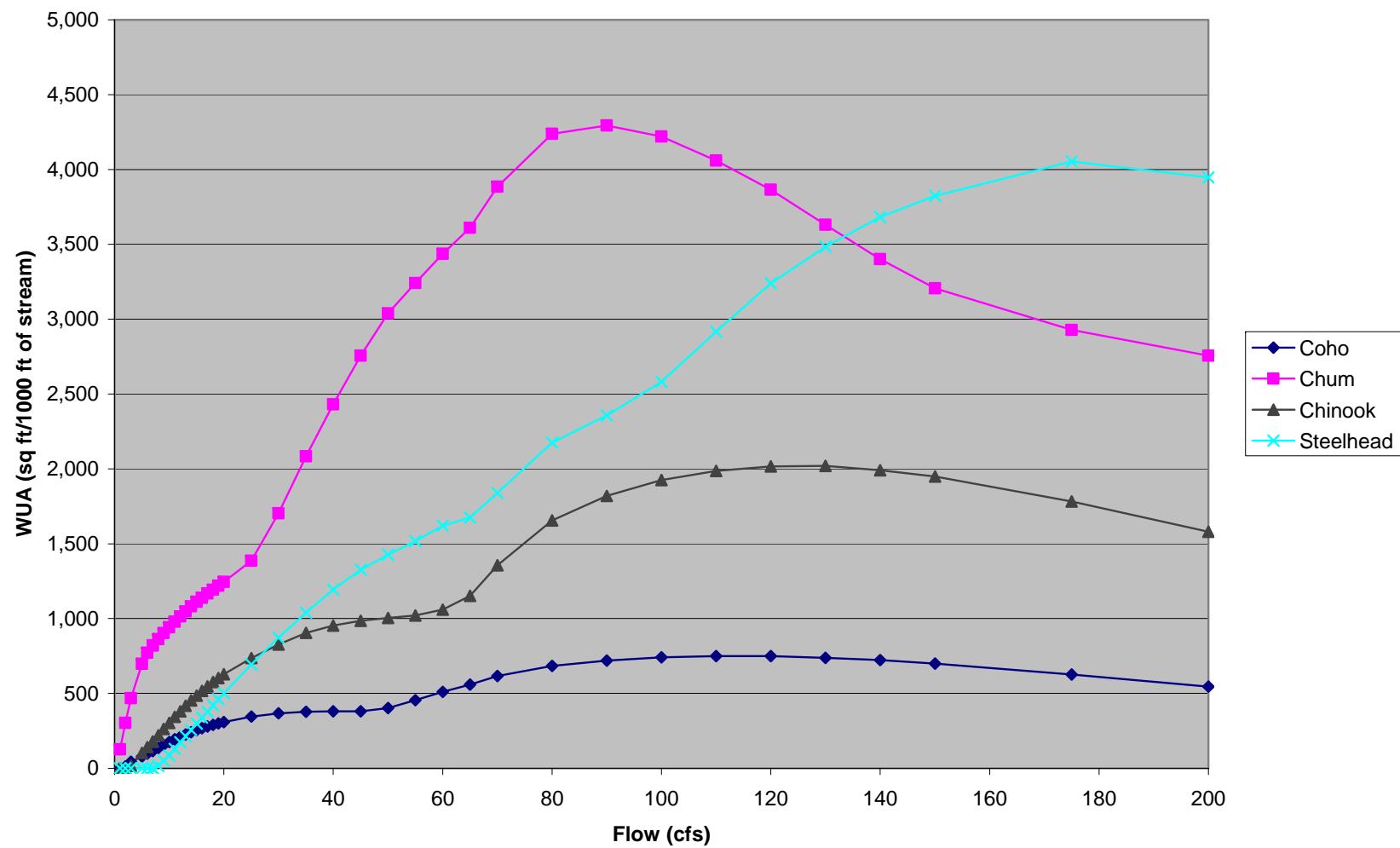
Prepared by:

**EES Consulting**

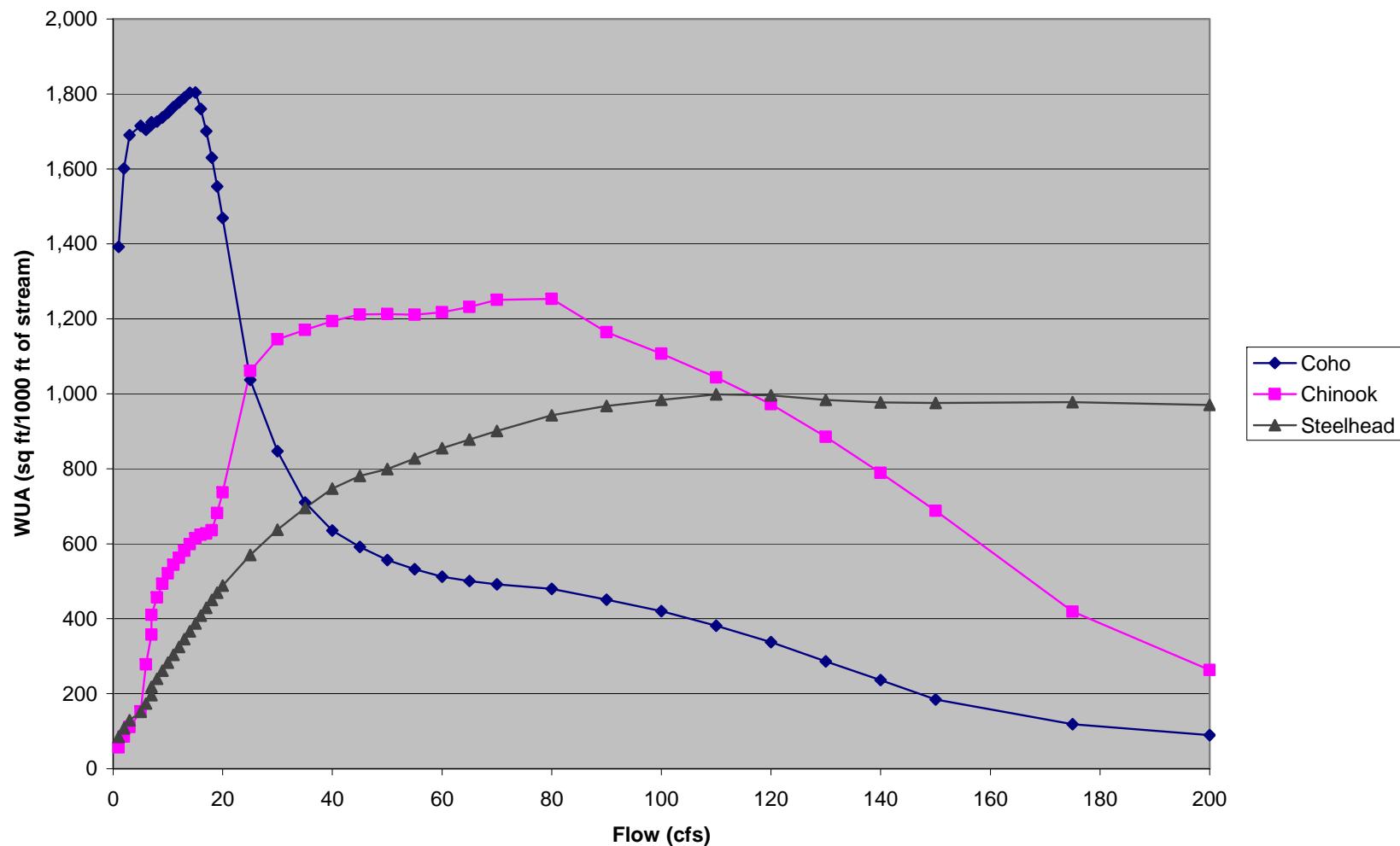
May 2005

Salt Creek Weighted Usable Area					Salt Creek Rearing WUA - Transects 2 – 4			
Salt Creek Spawning WUA - Transect 1					Flow	Coho	Chinook	Steelhead
Flow	Coho	Chum	Chinook	Steelhead	Flow	Coho	Chinook	Steelhead
1	0	127	0	0	1	1,392	57	85
2	11	302	0	0	2	1,601	85	108
3	44	469	17	0	3	1,690	111	129
5	79	698	103	0	5	1,715	153	152
6	97	772	142	0	6	1,704	278	174
7	117	820	179	0	7	1,718	358	196
7	117	820	179	0	7	1,724	411	218
8	137	863	220	15	8	1,727	457	240
9	156	903	263	50	9	1,737	493	261
10	175	942	304	86	10	1,750	521	283
11	193	979	343	130	11	1,765	544	304
12	210	1,014	381	173	12	1,778	563	325
13	226	1,049	418	215	13	1,790	582	346
14	241	1,081	453	257	14	1,803	599	367
15	255	1,111	486	298	15	<b>1,804</b>	615	388
16	267	1,140	517	338	16	1,760	624	409
17	279	1,167	547	378	17	1,701	628	430
18	290	1,193	576	419	18	1,630	636	450
19	299	1,220	603	461	19	1,553	682	470
20	308	1,246	629	501	20	1,469	737	489
25	345	1,386	737	693	25	1,037	1,062	570
30	367	1,704	828	873	30	847	1,145	637
35	378	2,084	904	1,040	35	710	1,170	695
40	381	2,430	953	1,195	40	635	1,194	747
45	380	2,755	986	1,327	45	591	1,211	781
50	402	3,040	1,004	1,427	50	557	1,213	800
55	454	3,242	1,020	1,518	55	532	1,211	827
60	511	3,436	1,060	1,621	60	512	1,218	855
65	559	3,610	1,152	1,674	65	501	1,232	878
70	616	3,885	1,356	1,840	70	492	1,250	901
80	684	4,239	1,656	2,174	80	480	<b>1,253</b>	943
90	720	<b>4,295</b>	1,819	2,356	90	451	1,164	968
100	742	4,220	1,925	2,582	100	420	1,107	984
110	749	4,060	1,986	2,917	110	382	1,043	<b>999</b>
120	<b>750</b>	3,865	2,017	3,240	120	338	972	996
130	739	3,630	<b>2,020</b>	3,483	130	286	885	984
140	722	3,402	1,990	3,682	140	237	789	977
150	700	3,207	1,949	3,825	150	185	688	976
175	627	2,928	1,782	<b>4,053</b>	175	119	419	978
200	545	2,757	1,579	3,947	200	90	263	971
Max WUA Flow	750	4,295	2,020	4,053		1,804	1,253	999
	120	90	130	175		15	80	110

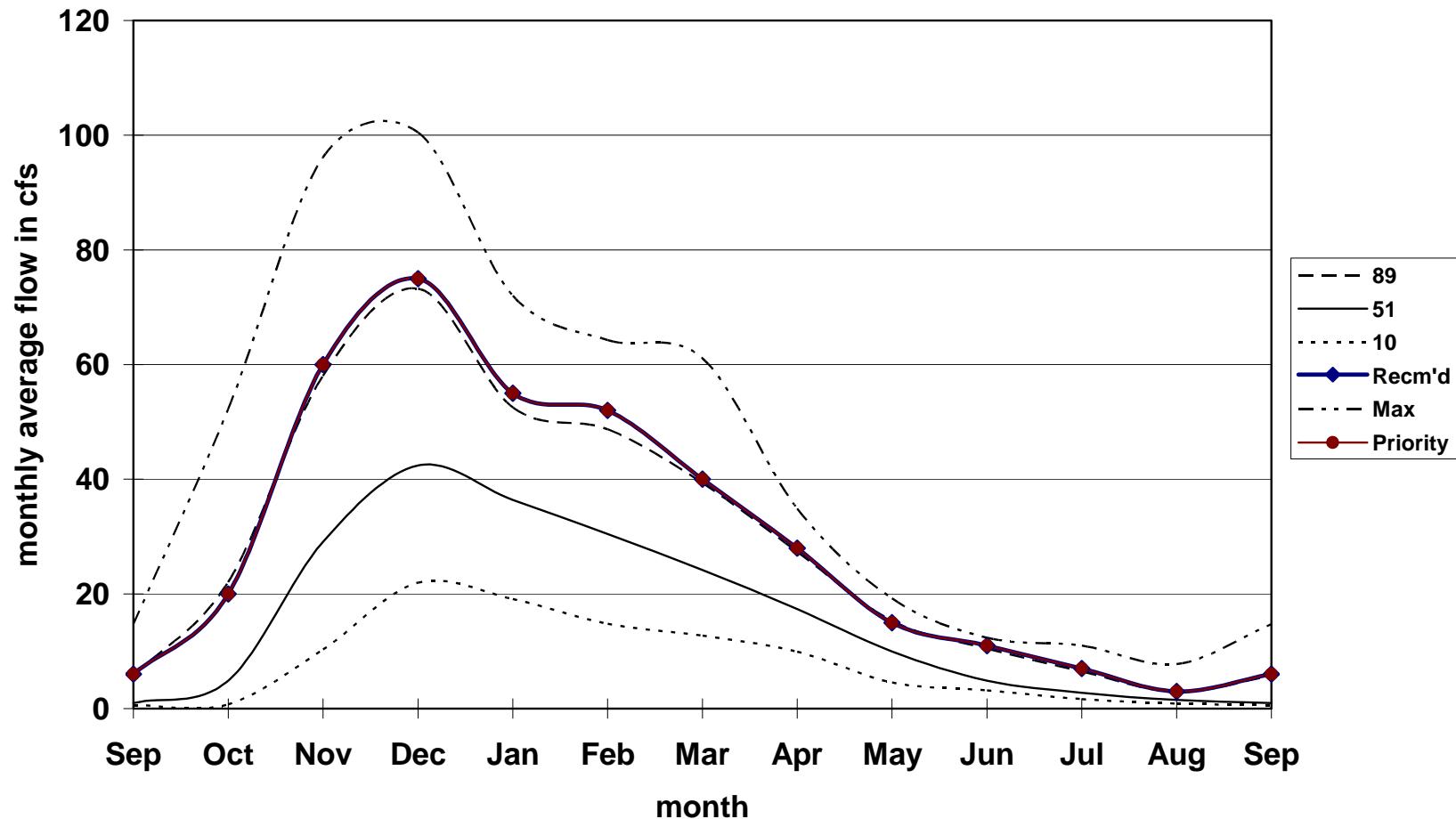
### Salt Creek Spawning WUA - Transect 1 - Riffle



### Salt Creek Rearing WUA - Transects 2 - 4



**Salt Creek at Outlet 1962 - 99**  
**% time flow less than or equal to**



<b>Summary of Flow Recommendations, Salt Creek</b>							
Max WUA (cfs)	ChS	CoS	CmS	SHS	CoR	ChR	SHR
	130	120	90	175	15	80	110
		Species and Life Stage		Suggested Flows		Hydrology	
Month/Days		Priority	Balanced	Mean	10% Ex	Comments	
Oct 1-15	<b>ShR</b>	CoR	25	25	11	25	15 Max
Oct 15-31	<b>CoS</b>		25	25	11	25	120 Max
Nov 1-15	<b>CoS</b>	CmS	60	60	33	60	90 Max
Nov 16-30	<b>CoS</b>	CmS	60	60	33	60	90 Max
Dec 1-15	CoS	CmS	<b>ShS</b>	75	43	75	120 Max
Dec 16-31	CoS		<b>ShS</b>	75	43	75	175 Max
Jan 1-15	CoS		<b>ShS</b>	55	39	55	175 Max
Jan 16-31			<b>ShS</b>	55	39	55	175 Max
Feb			<b>ShS</b>	52	33	52	175 Max
March	CoR	ShR	<b>ShS</b>	40	26	40	175 Max
April	CoR	ShR	<b>ShS</b>	28	18	28	175 Max
May	CoR	ShR	<b>ShS</b>	16	10	16	175 Max
June	CoR	<b>ShR</b>	ShE	11	6	11	15 Max
July	CoR	<b>ShR</b>		7	4	7	15 Max
Aug	CoR	<b>ShR</b>		3	2	3	15 Max
Sept	CoR	<b>ShR</b>		6	2	6	15 Max
CoR	Coho Rearing		ShR	Steelhead Rearing			
CoS	Coho Spawning		ShS	Steelhead Spawning			
ChR	Chinook Rearing		ShE	Steelhead Emergence			
ChS	Chinook Spawning						
Cms	Chum Spawning			<b><i>Bold = Priority Species</i></b>			

Salt Creek WUA using the balanced approach using the balanced approach of averaging WUA for species and life stages.					
Flow	ShR/CoR	CoS/CmS	CoS/CmS		ShS/ShR/ CoR
			ShS	CoS/SHS	
1	739	63	42	0	492
2	854	157	105	6	570
3	910	256	171	22	606
5	933	389	259	40	622
6	939	434	289	48	626
7	957	469	312	59	638
7	971	469	312	59	647
8	983	500	338	76	661
9	999	530	370	103	683
10	1,016	558	401	131	706
11	1,035	586	434	162	733
12	1,051	612	466	192	758
13	1,068	637	496	220	784
14	1,085	661	526	249	809
15	<b>1,096</b>	683	555	276	830
16	1,084	703	582	303	836
17	1,065	723	608	329	836
18	1,040	741	634	355	833
19	1,011	759	660	380	828
20	979	777	685	405	820
25	804	866	808	519	767
30	742	1,035	981	620	786
35	703	1,231	1,167	709	815
40	691	1,406	1,335	788	859
45	686	1,568	1,487	853	900
50	678	1,721	1,623	915	928
55	680	1,848	1,738	986	959
60	684	1,974	1,856	1,066	996
65	689	2,084	1,948	1,117	1,018
70	697	2,250	2,113	1,228	1,078
80	711	2,461	2,366	1,429	1,199
90	709	<b>2,507</b>	2,457	1,538	1,258
100	702	2,481	2,515	1,662	1,329
110	690	2,405	2,576	1,833	1,433
120	667	2,308	2,618	1,995	1,524
130	635	2,184	2,617	2,111	1,585
140	607	2,062	2,602	2,202	1,632
150	580	1,953	2,577	2,262	1,662
175	548	1,777	2,536	<b>2,340</b>	<b>1,716</b>
200	530	1,651	2,416	2,246	1,669
Max WUA	1,096	2,507	2,618	2,340	1,716
Flow	15	90	120	175	175